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TRANSPORTATION RATES AND COSTS FOR SELECTED VIRGIN AND SECONDARY COMMODITIES

MOSHMAN ASSOCIATES, INCORPORATED

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This report summarizes a study that compared the transportation rates for competing secondary (scrap) and virgin materials in five industries: iron and steel, glass, paperboard, rubber, and aluminum products. The three major points researched in the study are: whether rates are reasonable for each commodity; whether carriers discriminate against secondary materials in ratemaking to the benefit of the respective competing virgin materials; and the magnitude of the effect of transportation charges on commodity prices. For many moves, rate levels were found to be higher for iron and steel scrap than ore, for cullet than glass sand, for aluminum scrap than aluminum ingot, and for reclaimed than new rubber. Contrarily, rates for woodpulp were higher than for waste paper, and rates for new rubber were higher than for scrap rubber. Enlightened public policy requires the examination and removal of inequities at the detailed, individual movement level.

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PREFACE

This report was prepared by Moshman Associates, Inc., Washington, D.C., under Contract No. 68-01-0790 with the Environmental Protection Agency. Work was begun in January, 1973, and completed in June, 1973. The statements, findings and conclusions in this report are those of the authors and do not necessarily reflect the views of the Environmental Protection Agency.

The project director for Moshman Associates was David G. Abraham, vice president and director of economic research; William B. Saunders served as the senior project advisor.

The report was written by Messrs. Abraham, Saunders and Thomas G. Woodall, transportation economist. Other Moshman Associates staff members and consultants who participated in the research and report preparation were Dr. Jack Moshman, Dieter Harper, Leo Marcus, Mark Moshman, Byron F. Andrews, and Frank Piovia, who contributed to the chapter on product equivalencies.

This report has been reviewed by the U.S. Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the U.S. Environmental Protection Agency, nor does mention of commercial products constitute endorsement or recommendation for use by the U.S. Government.

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In a research project of this scope, involving five manufacturing industries, the cooperation of dozens of persons, companies and associations is vital to the success of the project. We are grateful to the countless individuals who provided the assistance necessary to achieve this undertaking's goals. Those who answered a single telephone inquiry, or responded to a traffic survey, are too numerous to list, but their help and cooperation are nevertheless sincerely appreciated.

Certain individuals and groups deserve a special note of recognition for their invaluable help, without which this project would have been stymied.

First, we are indebted to the personnel of the Office of Solid Waste Management Programs at EPA, which commissioned this study, and particularly to Lawrence B. McEwen, the project officer, an analyst in the Resource Recovery Division. Assistance in project design and evaluation was also provided by Arsen Darnay, then director of the Resource Recovery Division, John Skinner, chief of the Analysis Branch, RRD; and Stephen Lingle, an analyst in RRD.

Second, we wish to thank the personnel of the Bureau of Economics at the Interstate Commerce Commission for supplying a copy of the computer tape of the 1969 One Percent Sample of Railroad Waybills, and for providing assistance in decoding and analyzing data. We are especially grateful to Edward L. Margolin, who then was the bureau director (since retired), and to William A. Lesansky, James Nash, and Harvey Levine, all of the bureau.

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Dr. Herschel Cutler, executive director; Gerald S. Goldman, director of transportation; and Harold Pockrose, chairman of the transportation committee, Institute of Scrap Iron and Steel, Washington, D.C. (Mr. Pockrose is director of transportation for David J. Joseph Co., Cincinnati, Ohio); and James Hughes, director of public relations, American Iron & Steel Institute, Washington, D.C.

Paper

The Traffic Committee of the American Paper Institute, New York, N.Y., and in particular S. H. Tippett, director of traffic, Container Corporation of America, Carol Stream, Ill., and Glenn L. Fast, Corporate manager -- rates and regulation, Brown Company, Kalamazoo, Mich.; W. S. McClenahan, director, Division of Information Services, The Institute of Paper Chemistry, Appleton, Wis.; and A. T. Luey, manager, Boxboard Research & Development Association, Kalamazoo, Mich.

Glass

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Aluminum

Howard Ness, technical director, and John Vaccaro, director of transportation, National Association of Secondary Materials Industries, New York, N.Y.; R. M. Cooperman, executive director, Aluminum Recycling Association, Washington, D.C.; Charles Rosenbloom, executive vice president, and A. T. Super, general traffic manager, U. S. Reduction Co., East Chicago, Ind.

Rubber

W. James Sears, vice president, Rubber Manufacturers Association, Inc., Washington, D.C.; and Ted Newman, general traffic manager, Midwest Rubber Reclaiming Co., East St. Louis, Ill.

SUMMARY

This study was commissioned by the Environmental Protection Agency in December, 1972, "to examine and compare transportation rates for competing secondary (scrap) and virgin materials and to examine the basis for these rates."[1] Materials consumed by five industries were specified by EPA as objects of study: iron and steel, paper, glass, aluminum, and rubber.

To conduct this analysis of "competing commodities", six commodity pairs (including two in the rubber industry) were chosen. Attempts were made to relate consumption of those commodities and the destinations of their movements to specific industries, namely, integrated iron and steel plants, paperboard mills, glass container plants, secondary aluminum smelters, and reclaimed rubber plants.

Emphasis was placed on movements by railroad, this being the predominant mode for all, but perhaps one, of the commodities in this study. A sample of movements was selected for study from the 1969 One Percent Sample of Railroad Waybills. That sample, comprising 281 movements, was used for most of the analyses herein. It was shown to be statistically representative of the original One Percent Sample. However, due to different research methods, including a constraint that all movements chosen for study be in high-density corridors, the summary figures for the respective commodities are not comparable with the averages developed in the so-called "Burden Study".

Three major points were researched in this study: the reasonableness of the rates for each commodity, the fairness of the level of rates for secondary commodities, compared with their virgin counterparts, and the magnitude of the effect of transportation charges on commodity prices.

Average rates for all commodities were found to be in the zone of reasonableness, but there were numerous individual situations with such large differences that some inequities surely exist. Due to the many individual variations, gross averages tend to obscure the significance of the problems identified.

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[1] Article 1, Statement of Work, EPA Contract No. 68-01-0790.

Rate levels, on average, for many specific moves, were found to be higher for iron and steel scrap than ore, for cullet than glass sand, for aluminum scrap than aluminum ingot, and for reclaimed than new rubber. Contrarily, the rates for woodpulp were higher than for waste paper, and the rates for new rubber were higher than for scrap rubber.

Generally, revenues were found to exceed variable costs and to made fair contributions to fixed costs and profit. On average, the rate of contribution for three of the secondary commodities, ferrous scrap, cullet, and reclaimed rubber were from 18 percent to 123 percent higher than for their virgin material counterparts. However, the contribution rate for ferrous scrap was about the same as for ore in the 1-to-200 mile range of moves, where the preponderance of traffic was.

The wide variations in rates and their contribution to constant expense, both by commodity and among pairs of commodities, prove that carriers do not employ some rigid master plan in ratemaking and that they have given no consideration to the possible competition between virgin and secondary commodities. Because no conclusive finding has been made by the Interstate Commerce Commission as to the competition between these commodities, regulated carriers are not required to prevent any inequalities found in this study.

The rail rate structures for some disadvantaged secondary commodities are not designed to encourage heavier ladings of rail cars, probably to the detriment of carriers and shippers.

The analysis of transport costs relative to product values included a comparison of equal units of virgin and secondary materials. Means transportation rates for secondary materials ranged from six percent to 79 percent of the material values at their average source prices; the range for virgin materials was three percent to 171 percent. For cullet, waste paper, and ferrous scrap, transportation charges represent significant shares of delivered product prices, substantially more than for the respective virgin materials with the exception of glass sand.

General rate increases authorized by the I.C.C. since 1969 have maintained the approximate rate relationships described in this study. No action has been taken by the Federal regulatory agency to correct numerous specific rate inequities, many of which were identified in this study.

It is believed that railroads' and the public interest could be served by greater application of incentive rates for heavier ladings. Several secondary commodities are often loaded above prescribed minima without shippers receiving any share of the cost benefits realized by carriers.

If a finding as to the real competition between virgin and secondary commodities were made, the comparison of rates charged for such competing materials may be a test of rate discrimination. However, for a finding of undue prejudice to be made, proof that these rate inequities were the cause of injury must also obtain.

Contract and private motor carriage are increasingly participating in the transport of secondary materials, mainly for waste paper and cullet. These services are often rendered at charges below fully allocated variable costs. Though service costs, on average, exceed railroad rates for all but the shortest hauls, these motor carriers' services meet a common objective: secondary materials are transported at relatively low charges where rail services are unavailable, and the economics of carrier operations are improved through avoidance of empty backhauls.

The economic principles of round-trip contract carriage have not been reflected in railroad ratemaking for secondary materials. Whether such round-trip operations could be formally implemented and appropriately lower rates obtained was not determinable within this study's scope.

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I. INTRODUCTION

It has long been recognized that transportation costs play a vital role in the economic feasibility to utilize one raw material as contrasted with another. More recently, an increased awareness to the effect that the transportation cost factor may exert an even greater influence in the usability of secondary materials as raw material substitutes has been widely discussed by shippers and carriers, executive and regulatory agencies. Concerns have been voiced by several interest groups to the effect that some secondary materials are not accorded fair and equal treatment in the regulated transport carriers' ratemaking processes and that these practices unduly inhibit the utilization of these materials to the detriment of environmental and ecological protection.

This report contains the results of a study of selected virgin and secondary commodities representing the alternative basic materials for the production of five basic products, namely iron and steel, glass, paperboard, rubber, and aluminum products.

Findings are based mainly on data for the year 1969, the latest year for which the essential information was available.

II. SCOPE OF STUDY

Objectives

The principal objectives of this study can be summarized as the determination of the following:

a. Are transportation rates for each of the commodities selected for study reasonable, costs and other rate factors considered.

b. Are the carriers discriminating against secondary materials in ratemaking to the benefit of the respective competing virgin materials.

c. What is the magnitude of the transportation charges as a percent of each material's average delivered purchase price.

While emphasis was to be placed upon the movement of the commodities selected for study by rail, consideration was to be given to motor and barge transportation to the extent that these play an important role in the conveyance of the study commodities and data availabilities permit meaningful analyses.

Constraints

The project work scope contained a number of constraints. Among the significant limitations were the following:

a. No traffic surveys were to be undertaken; rather, existing data available from public records and such as might be made available by shippers were to be utilized.

b. No carrier operating studies were to be undertaken in order to identify peculiar characteristics attending to the provision of transport services for the study commodities as distinct from aggregated averages for all types of traffic.

c. Data available from or provided by agencies of the U.S. government were to be accepted "as is", except for the correction of obvious errors of a typographical, keypunching, data processing or related nature, if any.

d. Technological equivalency formulae for the various study industry products were to be adapted from reliable published sources and such changes in these formulae made as indicated in order to reflect the most recent expert thinking in the respective fields of technology. Overall, these formulae were not intended to be precise definitions of raw material consumption, but rather approximations of sufficient validity to permit their use for the calculations intended, namely the delivered cost and the transportation cost component contained therein of technologically comparable batches of virgin and secondary materials.

e. Calculations of product equivalencies, both virgin and secondary, in terms of comparative delivered costs were to exclude any consideration of cost factors other than delivered costs to the consumer of the average or specifically defined product mix; thus, cost variances in plant handling costs, energy requirements and the like were ignored.

f. Commodity prices were to be extracted from published sources and geographical differences ignored; thus, benchmark figures were to be developed rather than the specific delivered prices as applicable in each of the geographic regions.

Several other constraints were reflected in the study scope and research methods; those, however, apply selectively to specific tasks or subtasks and are noted in context with the discussions of these.

Not so much a constraint as a broadly applicable thrust of this study was its requirement to conduct an independent fact finding project rather than to examine and react to recent regulatory and judicial proceedings involving some of the study commodities. This is not to suggest that the contractor was instructed to ignore or that he was unmindful of such proceedings, in particular the Interstate Commerce Commission's Ex Parte 281, Increased Freight Rates and Charges 1972 (Environmental Matters).

Scope Details

The study scope consists of six (6) distinct tasks which are briefly summarized below. At the outset, the basic industries for study having been predetermined, the specific study industries or consumers and the specific commodities were selected. This selection process, performed in consultation with the E.P.A. Project Officer and representatives from the various industries, resulted in the selection of the consumers and commodities enumerated in Table 1.

Of the 12 study commodities selected, one, iron ore, was examined primarily for only a portion of its total logistics process, namely from a storage yard at a Great Lakes or Tidewater port; however, six domestic all-rail moves were also analyzed. One secondary commodity, reclaimed rubber, was examined for movements from its point of production to its consumers, while the movements of all other secondary commodities studied pertain to those from a collection and/or processing point to the same type of location as is applicable to the commodities' virgin counterparts. Thus, for example, the study moves of iron and steel scrap as well as iron ore both terminate at steel mills.

Selection of Study Routes

The preliminary work scope anticipated the feasibility of selecting a sufficiently large number of common moves for virgin and their counterpart secondary materials to obtain a representative sample of these commodities' movements by rail. Common moves were at first defined as identical origin and destination points; points are those for which a specific multi-digit code in the Standard Point Location (SPLC) file of the Association of American Railroads has been assigned.

As will be noted in the chapter dealing with data employed and study methodology, the latest available data for rail movements revealed only a very small number of common moves, as initially defined, and none for several pairs of competing commodities. (The term competing commodities as used in this report is not meant to imply that these commodities do, in

Table 1

INDUSTRIES AND COMMODITIES SELECTED FOR STUDY OF TRANSPORTATION RATES AND COSTS OF VIRGIN AND SECONDARY MATERIALS

	INDUSTRY (CONSUMERS)		VIRGIN MATERIALS			SECONDARY MATERIALS		
	SIC	Description	STCC	Description	From-To	STCC	Description	From-To
I.	3312-11	Blast Furnaces & Steel Mills - Fully Integrated	101	Iron Ore	Railhead-Plant	40211	Iron & Steel Scrap	Processor-Mill
II.	2631	Paperboard Mills	26111	Woodpulp	Pulp mill-Board mill	40241	Waste Paper	Processor-Board mill
III.	3221	Glass Containers	1441320	Glass Sand	Mine-Plant	3229924	Cullet	Processor-Plant
IV.	3341	Secondary Nonferrous Metals	33341	Primary Aluminum Ingot	Smelter-Secondary Processor	4021430	Aluminum Scrap	Processor-Secondary Processor
V.	3031	Reclaimed Rubber	0842325	Natural Rubber	Port-Plant	4026160	Scrap Rubber	Collection Point-Plant
			2821220	Synthetic Rubber	Manufacturer-Plant	3031190	Reclaimed Rubber	Plant-Manufacturer

fact, compete in the traditional sense in the marketplace. Industry experts suggest that effective market competition exists only for iron and steel scrap, aluminum scrap, paper waste, and reclaimed rubber from among the study secondary commodities, but not for cullet and scrap rubber.)

Consequently, the definition of common moves was revised to insure a valid comparison. The final criteria for an eligible study move were that it must be in a high-density corridor, and that it must have a common origin territory and a common length of haul (within 10 per cent plus or minus) with a move of its counterpart commodity. High density corridors were defined as those with a significant share of the traffic relative to other corridors; specifically, those for which the destination states receive at least 10 percent of the total traffic for the particular commodity and where each origin state matched with a destination state supplies at least 10 percent of the traffic moving to that destination. It should be noted that this factor was included in the selection criteria to preclude the selection of moves which are insignificant in terms of industry traffic, which may be occasional and incidental traffic and for which applicable commodity rates would be less likely to be representative of the rate levels applicable to the preponderance of that commodity's movements.

Since the redefined selection criteria made fewer common moves available for study, this selection process still was found to be unsatisfactory. For most of the study commodities the full distance spectrum was not represented.

Consequently, the selection process was expanded to include supplemental moves, so as to reflect, to the extent possible, for each commodity the entire distance range over which these commodities were observed to move in high density corridors.

Table 2 shows the rail moves selected for study from the two sources mentioned therein; it also shows the distance over which each commodity was found to move, the average lading per carload and the ratio of lading for virgin to secondary materials. It might be noted that the number of study moves selected for scrap and reclaimed rubber is still rather small. This is due to the small number of waybills contained in the data base, 11 for scrap and 20 for reclaimed rubber, approximately half of which were ineligible under the selection criteria; industry data were used to expand the sample.

Freight Rates

This task required the identification of the specific freight rates applicable to the commodity moves selected for study in the preceding task. In turn, these rates were to be compared for the competing virgin and secondary materials.

In view of the fact that these rates were also to be employed in a subsequent analysis, as described in section following, and the traffic and revenue data available for the most recent year are for the calendar year 1969, it was imperative to identify the rates then applicable rather than the current rates, which reflect general increases authorized by the I.C.C. in its several ex parte proceedings since the end of 1968.

Table 2

CARLOAD MOVEMENTS BY RAILROADS, SELECTED FOR STUDY FROM 1969 ONE PERCENT WAYBILL SAMPLE AND INDUSTRY FURNISHED INFORMATION

STCC No.	Commodity	Total Study Movements	Movements Distance Range[1/], mi.	Average Carload Lading, tns.	Ratio Lading V ÷ S
101	Iron Ore	26	600	76.3)	1.39
40211	Iron & Steel Scrap	30	1400	54.7)	
1441320	Glass Sand	21	2000	68.4)	1.08
3229924	Cullet	17	1000	63.2)	
33341	Aluminum Ingot	27	2200	57.9))	1.74
4021430	Aluminum Scrap	24	1200	33.3))	
0842375 2821220	Natural & Synthetic Rubber	29	2400	52.8[2/]	
4026160	Scrap Rubber	7	600	22.1))	2.39
3031190	Reclaimed Rubber	10	1000	46.3))	1.14
26111	Woodpulp	48	2400	58.2)	1.71
40241	Waste Paper	42	1800	34.1)	
	Total	281[3/]			

1/ Data were segregated by 200 mile blocks up to 2,200 miles; movements in excess of 2,200 miles distance, shown as 2,400 miles, may exceed that distance; distances refer to short-line mileage without circuity.

2/ Synthetic = 57.4; natural = 34.3.

3/ Excludes duplications.

Freight Charges

A distinction was to be made between rates identified for specifically selected study moves and the revenues reported for such moves by the respective railroads. The latter are contained in the data base employed and are stated to reflect the revenues obtained for each haul as shown in the carriers' audited waybills.

It would be entirely logical to expect no discrepancies between these reported revenues and the applicable rates identified in the tariff searches comprising the second study task. However, as was also noted in prior studies employing the same data base, such differences do exist with fairly high frequency and therefore the efforts entailed in a comparative study of rates versus reported charges appeared to be justified.

Carrier Costs

In this phase of the study the scope requires the determination of carrier costs for the provision of the transport services reflected in the study moves. Further, these carrier costs were to be compared with carriers' rates and/or charges to determine the reasonableness and equity of their relationships for the commodities selected for study and on a comparative basis the competing commodities in particular. The work scope specifications recognized, *a priori*, the limitation attending to this task. In particular, it was recognized beforehand that I.C.C. costing procedures for services by regulated modes of transport are designed, in the main, to reflect differences in costs due to the different types of equipment used, rather than differences specifically associated with or reflecting the characteristics of the various commodities transported and the specific points served. Of course, it is a distinct characteristic of fresh vegetables to require refrigerated cars for their transportation and consequently cost calculations reflecting those peculiar to reefer cars automatically reflect important characteristics of transporting that commodity.

Whenever possible, the requirements specified that cost factor adjustments be made to reflect commodity characteristics, so long as such adjustments are defensible on the one hand and do not entail special operating or cost studies per se on the other.

Reflection of Non-Cost Related Ratemaking Factors

This task recognized the reality that non-cost related factors play an important role in the ratemaking process, both from the carriers' and shippers' viewpoints. In particular, it was required to assess the specific effect the various non-cost factors may have had in the carriers' rate setting procedures. Put differently, to the extent that competing virgin and secondary commodities are rated at different levels and consequently provide different rates of contribution to carrier fixed costs and profit, the rationale employed by the carriers was to be examined and reflected upon.

Effects of Transportation Charges

In this concluding task, this study is to determine the relative effects of transportation charges applying to competing virgin and secondary materials, typically expressed as a percentage of the commodities' delivered price, including the cost of transportation contained therein.

Here, too, it was recognized beforehand that the mere comparison of transportation rates or charges applicable on some average basis and as a component of some average delivered price for each of the study commodities would not be a satisfactory or useful study product. Two interrelated reasons account for this. First, the competing commodities are not technologically comparable on a unit for unit basis; simply, a ton of iron ore is not comparable to a ton of iron and steel scrap. Second, utilization of the secondary materials selected for study in lieu of virgin materials, in most cases also requires substitution of or quantitative changes in the utilization of other materials. For example, the substitution of glass sand with cullet significantly affects the use of soda ash.

Consequently, the determination of the effects of transportation charges task has a prerequisite, namely the determination of product equivalencies to permit the subsequent comparison of appropriately adjusted quantities and mixes of virgin and secondary commodities. This prerequisite was included as an integral part of this scope item.

III. RESEARCH METHODS AND DATA EMPLOYED

Introduction

This report chapter contains a brief summary description of the principal research and analysis methods employed in the performance of the herebefore described work scope; the data resources utilized are also noted. To the extent practical, the chronology of these topics follows the task order described in the preceding section 3.

One Percent Waybill Sample, Computerized Processes

Prior to the initiation of the study, it had been determined to use, as the principal data source for study commodity movements, the 1969 One Percent Waybill Sample prepared by the Interstate Commerce Commission. Hence, upon determination of the commodities to be studied, an extract of the I.C.C. Waybill tape containing the full data base for the selected commodities was obtained from the Commission's Bureau of Economics. This extract tape was merged with a Standard Point Location Code (SPLC) data base in order to interpret the numerical origin and destination codes.

Subsequent to the performance of several control and correction computer runs of the "master tape", a master printout of all records in commodity order was prepared. A series of programs was then prepared to permit the resorting and extraction of selected items from this data base. Among these were programs designed to obtain listings of perfectly matched moves, e.g. same origin and destination points for the commodity pairs, moves with common origins, common destinations or common destination territories. Next were a series of programs for analytical functions including summations of moves expressed in numbers of waybills, cars, tons, ton-miles, revenue, type of rate, and predominant type of car used.

Upon determination of the final "common move" selection criteria, programs were prepared to select the waybill data corresponding to the defined criteria. For the resulting subsample of the I.C.C. furnished data base, printouts were prepared containing the information needed for tariff searches and costing. To determine the representativeness of the common moves selected for study in terms of distance, a program was designed and an analysis prepared of all waybills and selected waybills by 200-mile blocks, by origin territory, destination territory and high density corridor. This revealed gaps of representation. Thus, for example, common moves which did not contain some hauls were corrected by adding "supplemental moves", chosen from the hitherto unrepresented mileage blocks. This additional selection process was performed manually; the only constraints placed upon it were that the supplemental moves be from among those in high-density corridors, that to the extent such were available in the computerized data base and/or from industry furnished data, no fewer than two moves per mileage block be selected and that the combined number of common and supplemental moves be no less than 25. (These objectives were not reached for several commodities due to data deficiencies.)

Finally, a summation and analysis of all waybills contained in the data base was completed; it was organized by destination territory and contained totals and averages respectively for tons hauled, revenues billed, loaded car-miles and revenue ton-miles, revenues per car and per ton, per car-mile and per ton-mile.

1.2 Industry Furnished Data

Through the auspices of the various trade and industry associations, requests were made for the provision of movement data for the respective virgin and secondary commodities by all applicable modes. Each participating organization was requested to supply pertinent information on at least five hauls, chosen from among recurring movements and without bias as to their relative rate levels.

Industry participation turned out to be substantially less than was anticipated, particularly in those industries for which the Waybill data base also provided less than the desired volume of information. However, paper board industry participants did conduct a survey of their inbound movements for a randomly selected work week.

Another facet of industry participation dealt with the reconciliation of carrier rate and charges data. As noted in the section following, the tariff search results were compared in all instances with the revenue information contained in the Waybill file. Where differences between the figures could not be explained or rationalized with the information in hand, shippers of the respective commodities were queried for reasons explaining these unreconciled differences.

To secure any available operating and cost studies which would permit the derivation of adjustments to the available cost factors, extensive enquiries were made among industry associations and their members. Regrettably, these efforts resulted merely in the confirmation that such data were not available on any basis which would permit their use in the context of this study. Review of data available from several large shippers showed that cost studies made by them either employed regional cost factors or specific cost factors applicable exclusively to a particular location or specific origins and destinations.

Finally, industry traffic officials were also consulted to obtain their views on rate and cost aspects and product equivalencies.

1.3 Rate Search

Using the computer printouts noted before as the requirement log, the tariffs on file with the I.C.C. were searched for identification of the published rates applying to each of the study moves. This tariff search procedure included the location of Rate Bureau Tariffs covering the origin and destination points or group of points and tariffs published by agents for a particular carrier. Where Bureau and specific carrier tariffs were found to apply to a particular move, that rate which either equalled or came closest to the revenue shown in the Waybill data was used. In addition to identifying the rate per unit of weight and the minimum weight required per carload, these tariffs were also examined for any special provision in these categories: limitations on applicable equipment, accessorial charges, special rules on free time for loading and unloading, equipment supplied by shippers. Though these types of special tariff provisions are not the only significant rules, they were judged to be those having the greatest economic impact upon the users of these rates. Put differently, often a rate _per se_ is not

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the only economic factor of significance to the shipper; if the tariff restrains the rate's applicability to a loading period of 24 hours, for example, and it requires special efforts, such as overtime work, to meet that requirement, what may appear to be a relatively low rate, could in fact be a much higher rate when the cost of premium overtime is also taken in consideration. These special provisions were impossible to quantify under the constraints of this study, but their existence is noted in our analyses.

The rate information obtained from these tariff searches was compared with the rates derived by dividing the revenue shown in the Waybill data file with the quantity of each study move (revenue ÷ tons). Where discrepancies were found to exist, the following procedure was adopted:

a. The derived rate was examined to determine whether the minimum weight had not been met and therefore a higher rate per unit of weight was billed.

b. The derived rate was examined to determine whether an intrastate or switch rate might apply which was not found in the tariff searched.

c. The tariff was rechecked.

d. Industry traffic officials were consulted to ascertain the cause of the discrepancy (it should be noted that no reasonable method could be developed to check the accuracy of the revenue figure, and for that matter any other figures, contained in the Waybill file, as access to and detailed examination of the hundreds of waybills was not feasible).

Any remaining unresolved differences were then treated as follows:

a. For industries where only a few discrepancies remained and the rates obtained from tariff searches mostly corresponded with the derived rates, tariff figures were used consistently for these industries; this is the case for the iron and steel, secondary aluminum and paperboard industries.

b. For those industries where greater numbers of discrepancies were observed and remained unreconciled, the lower of the published or derived rates was uniformly used. This method assumes that where the derived rate was shown to be lower than the lowest published rate found, some special rate applicable to a particular move may have been published in a tariff supplement not located during the tariff search. Of course, this phenomenon, where the reported revenue is lower than the apparently applicable rate provides for, can also mean that some lower inapplicable rate was in fact used.

c. Finally, the existence of errors in the Waybill revenues and/or tonnage data cannot be dismissed. Though carriers are to have reported these data by submitting copies of audited waybills, there is ample opportunity for human error to be contained in the information reported to the I.C.C. and in the processing functions creating the Waybill file. As noted before, no method could be devised to remove these types of errors from the file, if indeed they exist.

Motor carrier rates furnished by industry sources included tariff citations; spot checks only were made of these rates and found to be accurate.

All rates searched were established at the 1969 rate levels, generally and where applicable including the Ex Parte 259 B increases authorized by the I.C.C. as of November 28, 1969.

Costing

Though we are keenly aware of the often voiced deficiencies and inadequacies of the costing methods devised by the Section of Cost Finding of the I.C.C., there is no other costing method presently available which can be applied on a uniform and unbiased basis to traffic consisting of different commodities and moving in all parts of the Nation. Consequently, we have followed the procedures prescribed by the application of Rail Form A (RFA) and Highway Form B, and in particular have applied the Rail Carload Cost Scales by Territories for the Year 1969 (Statement No. 1C1-69, issued by the I.C.C. as information but not adopted by the Commission). For the small number of motor carrier moves costed, cost data were extracted from Statement No. 2C1-70, Cost of Transporting Freight by Class I and Class II Motor Common Carriers of General Commodities, also issued as information by the I.C.C. Bureau of Accounts.

While a full description here of these procedures would result in an unduly long and unnecessary description, the following highlights are necessary to provide information on the specific processes followed:

a. For each commodity a predominant type of car was selected based on the information contained in the Waybill file.

b. The cost factors for each type of car and each of the seven cost regions were assembled resulting in four cost factors, two each for terminal and line haul cost calculations.

c. These cost factors were modified for iron ore to reflect studies by the Section of Cost Finding and cooperating railroads; these adjustments have cost reducing effects as follows:

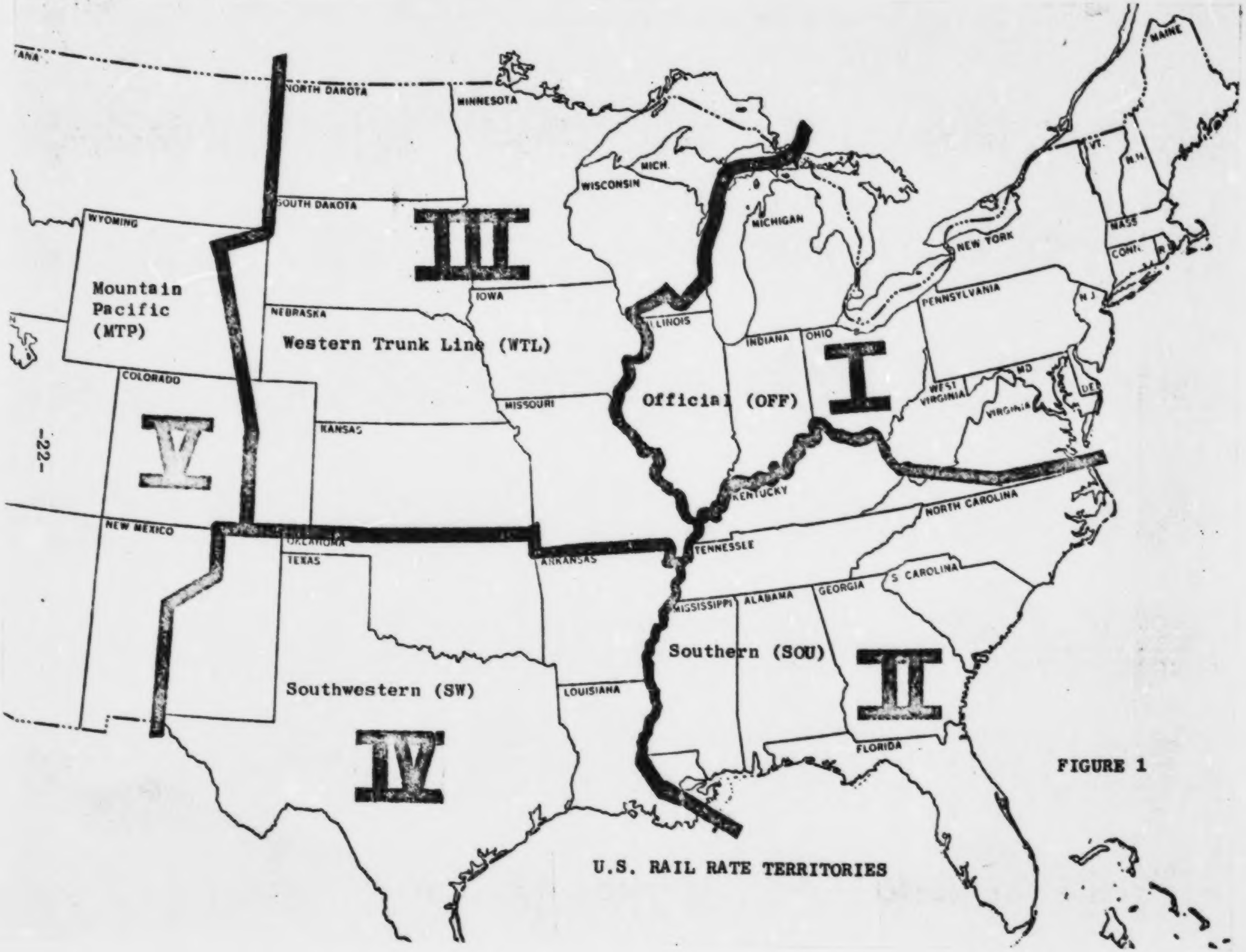
		Cost Region III per cent	Cost Region VII per cent
Line haul	per ton	26	27
	per car-mile	11	18
Terminal	per car-load	51	51
	per ton	none	none

The effect of these cost factor adjustments as compared with the results obtained from costing of study moves by application of the unadjusted regional cost factors were for hauls in the various mileage blocks as follows:

	Per Cent Reduction Of Variable Costs
Haul distance up to 60 miles	42
61-150 miles	35
151-350 miles	26
Over 351 miles	23

For each of the study rail moves a computer printout was prepared showing, inter alia, origin and destination territory, short line mileage and the code for the origin carrier. Each move was then assigned to a cost region based on the groupings the origin carriers are assigned by the I.C.C. Cost Section. It is to be noted that rate and cost regions are not synonymous, though in large measure they overlap. Cost regions are not generically geographic regions; they represent groupings of specific carriers and sub-groupings for two of the territories. Figure 1 following shows the five rate territories. Territory I, Official, is divided into cost regions I - New England, and II - Official excluding New England; similarly, rate territory V covers the approximate geographic areas of cost territories V, Western District, excluding Mountain Pacific and VI, Mountain Pacific, and Trans-territory.

While for intraregional moves the cost factors for the appropriate region were applied, for interregional moves the following procedure was followed: the shortest available route was identified by tracing the haul on a standard railroad map; the mileage for each participating carrier was calculated and all segments summed; this total was compared with the total short line miles shown in the Waybill file; the difference between these totals, if any, was ascertained and applied on a percentage basis to each segment of the interregional move. The resulting mileages were applied to the line-haul cost factors for each of the applicable cost



Mountain Pacific (MTP)
Western Trunk Line (WTL)
Official (OFF)
Southern (SOU)
Southwestern (SW)
I
II
III
IV
V
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
IOWA
COLORADO
KANSAS
MISSOURI
NEW MEXICO
OKLAHOMA
TEXAS
ARKANSAS
LOUISIANA
WISCONSIN
MICH.
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
S CAROLINA
NORTH CAROLINA
FLORIDA
WEST VIRGINIA
VIRGINIA
MD
DEL
PENNSYLVANIA
NEW YORK
N J
CONN
R I
MASS
VT.
N.H
MAINE

FIGURE 1

U.S. RAIL RATE TERRITORIES

regions. Terminal costs were calculated by applying origin terminal costs at the level of the origin cost region and destination terminal costs at the level of the destination cost region. No adjustments were made for the specific numbers of line-haul interchanges inasmuch as the calculated routing is not necessarily the actual routing for that traffic. The origin carrier will normally move the traffic for the greatest possible distance over its line, thereby minimizing the number of interchanges, whereas we calculated the shortest distance, consistent with the short line mileages contained in the Waybill file.

The resulting variable cost calculations for each study move were then posted to the Master Tables, Appendix A, and the therein shown calculations of revenue to variable cost relationships performed.

Contribution

The term contribution, as used in this report, refers to that share of carrier revenues realized for a particular haul or number of hauls, which exceeds the calculated variable costs incurred in the performance of those transportation services. Thus, contribution as a percent of revenue means total revenue less variable costs with the difference divided by revenue. Contribution per car means total revenue less variable costs per car.

Inevitably the question is raised "what about fixed or constant costs?" The Section of Cost Finding has devised methods for the allocation of constant costs. While these methods are recognized as having some limited value in certain cases of overall revenue need analysis, allocation of constant costs is not useful in the context of this study. By definition, these costs are not variable with traffic--they exist regardless of the presence or absence of any particular traffic. They are therefore unallocatable on the basis of any cost-causing responsibility to any traffic.

It is true that there are numerous ways in which rail constant costs may be distributed for accounting reconciliation purposes. These include:

a. ton and ton-mile basis
b. car and car-mile basis, similar to the RFA ton and ton-mile basis
c. carloads originated and terminated
d. loaded car-miles
e. loaded and empty car-miles
f. tons originated and terminated
g. net ton-miles
h. constant costs as a percentage of out-of-pocket cost separately for line haul and terminal
i. constant costs as a percentage of out-of-pocket cost without regard to line haul and terminal

Application of these methods in one test case would have produced constant costs of $1.69 to $2.96 per ton, the low representing the car-load basis and the high the net ton-miles basis, c. and g. above respectively.

The essential fact is that carrier pricing policies should and do recognize the presence of both variable and fixed costs. The function of costs is limited to the determination of a "rate floor" reflecting the variable costs, including operating expenses and capital costs. Beyond that cost floor the ratemaking process is not tied directly to costs. Instead, the ratemaking factors discussed in a later chapter of this report come into play in determining the level of rates. Put succinctly, fully allocated costs, e.g., variable plus constant costs, serve no purpose in the railway ratemaking process. (Variable costs are those which vary directly with changes in the carrier's operations or volume of traffic; they are the minimum level of expenses which must normally be recovered by a carrier in providing particular services. Fully allocated costs, on the other hand, are variable costs plus those constant costs which are assignable to particular services.) The judgment of the rate maker is applied typically to determine how far above variable costs he can fix the rate and still move the maximum amount of traffic. The object, in principle, is to obtain from each segment of traffic the maximum total contribution to fixed costs, subject to overall constraints on total return on investment and other elements contemplated by the Interstate Commerce Act. Tests of discriminatory rates, however, do not rest on arbitrary allocations of constant costs.

In this study, contribution is that share or amount of carrier revenues which exceeds the cost floor. It is important to remember that contribution is not synonymous with profit or return on investment; rather, contribution here represents the rough equivalent of gross margin or the product of revenue less direct costs in a manufacturing operation and that this contribution is the sum of money from which carriers must defray their fixed costs and earn a return on their investment. This comparison is imprecise to the extent 1969 railroad variable cost factors also include an element for cost of capital which is not the case in conventional gross margin calculations.

Cost of capital included in the cost factors applied in this study is defined as the interest payments on outstanding debt; it, too, is separated between variable and constant portions. Axiomatically, return on the equity portion of carrier property is excluded from the variable cost factors.

Statistical Analyses

Study Industries

The work scope was designed to include a statistical analysis relating the cost of transportation incurred by the selected industries, to the extent geographical differences exist, to the production of these industries on a comparable geographic basis. To this end attempts were made to identify the location of the selected industries' plants, and their production in terms of value of shipments or value added by manufacturing. The purpose of such an analysis would be the development of some estimates showing the effects of geographically different transportation costs--be they due to variation in transport service pricing by the carriers, relative distance of plants to their sources of supply, or other causes--upon the national output of these industries.

Several causes prevented the completion of this effort as originally conceived. However, average transportation costs for rail movements by rate territories were developed and for most of the industries the collateral effect of the geographic differences was related to output.

Among the causes precluding the intended analysis are the inconsistencies in the statistical series available for the various study industries, the aggregation of data to avoid disclosure of proprietary information and the impossibility to determine whether movements for the study commodities were, in fact, destined for plants in the selected industries or others using the same materials.

The geographical overviews developed with the available data were applied to obtain estimates of the effects of rail freight charges by applying the territorial rate averages.

Trend of Rates Over Length of Haul

The behavior of the rates relative to costs was analyzed by length of haul. Since rates for any given commodity are not literally based on mileage alone, it has been found that often two movements of the same distance in different areas may pay different rates. Hence, for purposes of a trend analysis, averages must be developed. This objective was met by application of regression techniques. The methods and results are detailed in Appendix B.

To avoid undue influence of atypical rates, observations which were found to be clearly outside a normal pattern for reasons which could be explained were excluded from the regression analysis. For example, unusually low intrastate rates for moves between a "captive" origin and destination were excluded. These are moves between shipping points controlled by the same organization, oftentimes involving dedicated equipment in shuttle service for which sometimes special point to point rates are made. Importantly, moves of this type and others which were found to take unusually low rates also incur lower than average variable costs. Hence, their inclusion in the regression without appropriate cost adjustments would cause distortion. These moves are noted in the figures contained in each of the industry-commodity sub-chapters.

Representativeness of Study Moves

In order to determine whether the moves selected for study for each of the eleven commodities (synthetic and natural rubber counted as one commodity) are representative of the universe of traffic contained in the Waybill sample, sets of randomly selected observations were tested against the study moves.

The statistical techniques applied and the table of resulting values are contained in Appendix C. These random sample tests confirmed that both sets of data were of the same family; in only one case was there a significant difference at the five percent level and it was only marginally greater than the five percent value. This result is well within the bounds of chance and does not impair the validity of the findings.

Product Equivalencies

To permit the derivation of the effects of transportation charges upon the prices paid by consumers for the competing commodities--a principal objective of this study--it is necessary to define the technological equivalencies for the competing commodities. As used here, the term technological equivalency is to be understood to mean the quantities of a virgin material needed to produce a given quantity of output as compared with the quantity of a secondary commodity needed to produce the same output; e.g., a ton of waste paper and .88 ton of woodpulp produce an equal amount of paperboard.

While it is recognized that great variations exist between different grades, qualities, and the specific methods of production in each industry, broad approximations of product equivalencies are useful in developing general industry relationships. Certainly, the factors cannot be used for any individual plant.

The methods employed to develop the needed equivalency formulae included the review of existing literature and personal contacts with technical industry experts. For several of the industries rather widely differing opinions were noted. One such, concerning the appropriate quantity of coal to be included in the steel making formula, is found in an order of the I.C.C. (Environmental Impact Statement; page 100) and a study by Battelle Memorial Institute (*Summary Report on the Impact of Railroad Freight Rates on the Recycling of Ferrous Scrap*, to the Institute of Scrap Iron and Steel, Inc., January 14, 1972, page 13). This difference appears to revolve around the question of whether coal for the supply of heating energy must be included to develop comparable values for a formula comparing the use of iron ore versus scrap.

The procedures adopted by us have consistently excluded the energy component except where a fuel is required to perform a chemical transformation for one material but not for the competing material. An example is iron ore which requires coke for the oxygen reduction which is not needed when scrap is used.

Effects of Transportation Charges

This step requires the application of delivered product prices (including the transportation component) to the product quantities determined in the equivalency formulae.

Various sources were used for the identification of product prices; in the selection of sources emphasis was placed upon their reliability. While data contained in price series published by agencies of the Federal government were generally accepted as reported by those agencies, other sources (mostly industry and trade papers) were also consulted to determine whether any significant variations existed. Where the latter type source was used, efforts were made to determine the validity of the methods employed by the source in collecting the information. The results were subjected to review by industry experts and adjustments made to reflect their comments. For example, the average price of scrap paid by the integrated steel industry consists of a certain mix of different grades, excluding those grades which are predominantly used by foundries.

Where significant differences in product prices, excluding the transportation component, appeared to exist on a geographical basis, national averages, if available, were used. In other cases where a national average was not available, multi-locational averages were developed by weighing consumption figures for the various regions with the prices reported for each of these regions.

The transportation component, either included in the delivered material price or added to the price f.o.b. the supply source, was developed by calculating the mean transportation charge for the study moves. The mean movement distance applicable to the calculated transportation charge was also developed. Consequently, except for the relatively small geographical differences in transportation charges by rail, the tables developed permit estimation of transportation charges for any distance within the mileage ranges applicable to each commodity. Such estimates, though they may not accurately reflect the freight charges incurred by any specific plant, can be useful in determining the approximate range of charges applying to consumers of virgin and secondary materials in the various rate territories.

In addition to the application of this mean value, the high-low range of transportation charges was also computed for study commodities by using the average of the two highest and the two lowest rates found among the study moves.

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Consequently, it was feasible to apply a high, a low, and a mean rail transportation charge to the respective quantities of study commodities.

For non-study commodities, such as coal and limestone, national average rates as shown in DOT Statement TD-1 were used. For commodities for which specific figures were not available in TD-1, either the closest commodity aggregation was used or a sample of rates was collected from published tariffs. Generally, the transportation charges for these miscellaneous commodities are of minor significance.

IV. INDUSTRY-COMMODITY ANALYSES

This chapter contains data and findings for each of the study industries--commodities for the work scope items described in Chapter II. The methods and data described in Chapter III were generally employed; exceptions are noted in specific industry subchapters. In the main, this chapter's analyses deal with the cost related aspects of rates paid by the consumers of transportation services. Findings applicable to more than one industry or pair of commodities are summarized in the concluding chapter section.

Iron and Steel Industry

Introduction

The integrated steel industry, SIC 3312-11, consists of plants producing both pig iron and steel. These plants convert iron ores and other raw materials to intermediate iron and steel products. In their manufacturing processes they produce and consume iron and steel scrap; most of the scrap produced in the pig iron and steel making process, called home scrap, is reused by the same mills. However, these integrated plants also purchase scrap and consume it as a substitute for iron ore, coke, and limestone.

The integrated part of the industry is the producer of the largest share of the Nation's steel production. In 1970, the plants categorized in the above named SIC numbered 59 (Iron and Steel Works Directory, American Iron and Steel Institute, New York). Of these, 16 were in Ohio, 15 in Pennsylvania, five in Illinois, four in Indiana, and four in New York; the remaining 15 plants are located in ten states including three each in Michigan and Alabama, and two in Texas. As evident from this geographic breakdown, shown in Figure 2, the industry is heavily concentrated in the northeast and north-central regions. Figure 2 also contains the value of shipments for each region, and the national total for the year 1967. The latter total of $9.7 billion is over 63 percent total steel mill products shipments in that year. The integrated industry consists mainly of large plants. According to U.S. Bureau of Census data, Concentration Ratios in Manufacturing, MC 671(S)-2.1 and MC 67(S)-2.3, the four largest manufacturers accounted for 51 percent of total shipments and the eight largest ones for 69 percent of the total.

While this segment of the steel industry consumes most of the iron ore, it is not the largest consumer of purchased scrap. The non-integrated steel industry includes electric furnace plants which consume almost exclusively purchased scrap as their primary raw material charge.

The Commodities

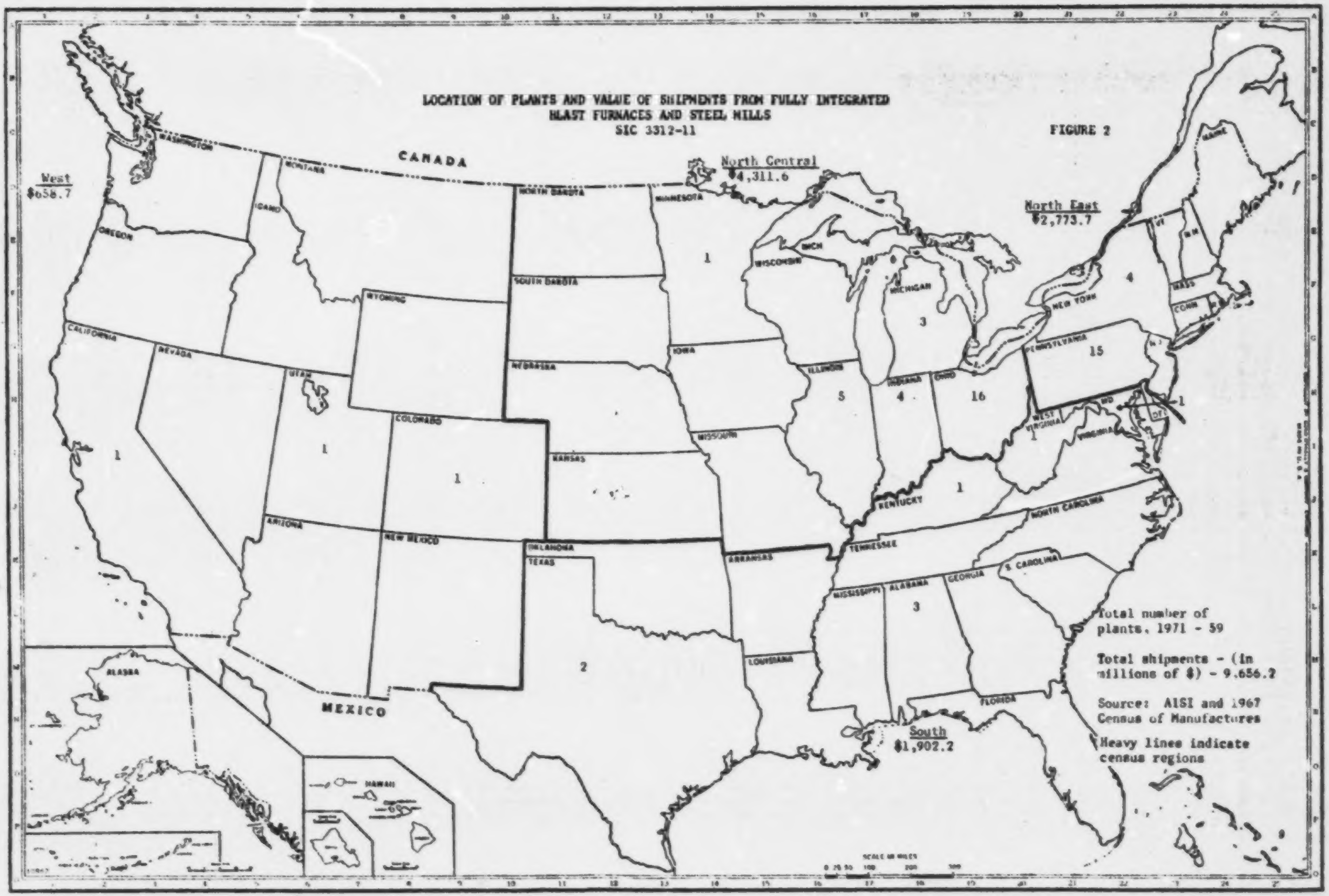
Iron ore and iron and steel scrap were chosen as the competing commodities for the analysis.

Most domestic iron ore is mined in the Lake Superior region, primarily in the Mesabi Range of Minnesota. It moves by rail to Lake Superior ports, then by lakers to consuming mills on the lakes, or to lower lake ports for transloading to rail cars, thence to interior destinations. A small amount of Mesabi ore is shipped all-rail to consuming plants. Ore is also mined in small amounts in various Southern and Western States.

Import ores come principally from Canada (via the Great Lakes) and South America (via the ports of Philadelphia,

FIGURE 2

LOCATION OF PLANTS AND VALUE OF SHIPMENTS FROM FULLY INTEGRATED BLAST FURNACES AND STEEL MILLS
SIC 3312-11


CANADA
MEXICO
West
$658.7
North Central
$4,311.6
North East
$2,773.7
South
$1,902.2
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICH
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
MD
DEL
PENNSYLVANIA
NEW YORK
N J
VT
N H
MASS
CONN
MAINE
ALASKA
HAWAII
1
1
1
1
2
1
5
4
3
16
1
1
3
15
4
1
SCALE IN MILES

Total number of plants, 1971 - 59

Total shipments - (in millions of $) - 9.656.2

Source: AISI and 1967 Census of Manufactures

Heavy lines indicate census regions

Baltimore, and Jersey City) to consuming plants. Imports have increased in recent years as the high-grade ores of the Mesabi Range have been gradually exhausted.

Three types of iron ores were included in the 1969 one percent sample of waybills: direct-shipping ores (STCC 10111), beneficiating grade ores (STCC 10112), and iron concentrates (STCC 10113); no movements of beneficiating grade ores matched any movements of scrap, so that this type of ore was excluded in the study. This exclusion is of no importance, however, since no distinction was made among the various types of ores in this study except in determining applicable rates.

Iron and steel scrap is used in furnaces and foundries as a source of iron. It is graded according to source, cleanliness, iron content, and size. Consumers obviously prefer scrap with a known composition and a known source; sellers are required to abide by specifications promulgated by ISIS[1], and prices are set in accordance therewith.

The Bureau of Mines reported in a news release, December 27, 1972, that approximately 89 million short tons of scrap were consumed domestically in 1972, and another 7.5 million tons were exported. The record year for ferrous scrap consumption was 1969, when mills and foundries used 94.8 million tons.

Three categories of iron and steel scrap are recognized: (a) Home scrap, generated in iron and steel furnace operations and rolling mill operations. It is usually reused in the same facility where it was created and hence is not transported. (b) Prompt industrial scrap, a by-product of the iron and steel fabricating industry. (c) Obsolete scrap, which includes such items as automobile hulks, used railroad cars and equipment, and incinerator and dump salvage.

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[1] Specifications for Iron and Steel Scrap 1971, Institute of Scrap Iron and Steel, Inc.

Movements of both prompt industrial and obsolete scrap (collectively called purchased scrap) were included in this study, but no attempt was made to distinguish between the two types for transportation analyses.

Transport Characteristics

While nearly all of the iron ore consumed in this country moves by rail, most of it also moves by water at some stage. Of the 26 ore movements in the study sample, all but five were ex-water, the railroad origins being either East Coast or lower Great Lakes ports.

Waterborne Commerce of the United States, Calendar Year 1970, published by the Corps of Engineers, shows that 47.9 million short tons of ore were imported, 6.1 million tons were exported, and 72.2 million tons were moved in lakewise service (exclusive of lakewise moves from Canada). Class I railroads hauled 104.2 million tons of ore that year.

We have examined only that portion of iron ore transportation which is comparable to iron and steel scrap, and have not attempted to construct a model that includes all the transportation from mine to steel mill. Thus, for intermodal movements of ore, we have included only the ex-water rail costs and revenues in the study.

Ore is very heavy loading; the Department of Transportation's publication TD-1, Carload Waybill Statistics, 1969 reported an average load of 76.2 net tons per car in that year. With few exceptions, ore also moves in multiple-car and trainload lots; the DOT report shows there were an average of 70 ore cars per waybill. The average move in 1969 was relatively short--239 miles.

Due to the geographical concentration of iron ore, just a few railroads traditionally have handled the bulk of the ore traffic. The Duluth, Missabe & Iron Range Railway in the Lake Superior District, and the Bessemer & Lake Erie Railroad and the Detroit, Toledo & Ironton Railroad on the other end of the lakes, have been the main ore carriers for decades. Others, such as the former New York Central, the Erie, and the Reading have also handled large quantities.

With the ore supply coming increasingly from Venezuela and other foreign points, other railroads have begun to share in the ore traffic. The Baltimore & Ohio, the Western Maryland, and the Penn Central are now handling large volumes of ore through East Coast ports.

The scope of the ferrous scrap transportation study was also limited to movements from collection or processing points to mills; movements to the initial collection points were not examined. These excluded movements are part of the total logistics process, and affect the total price of scrap. However, most are performed by exempt carriage; little data about them are available. These movements represent a collection, rather than a line-haul function. This study was concerned with line hauls exclusively.

Iron and steel scrap moves to mills, in the main, by rail, for several important reasons. Ferrous scrap is heavy loading and lends itself to bulk rail movements. For safety reasons, trucks generally are discouraged from entering most mills. Further scrap is sold subject to weighing and inspection at the receiving mill; rail cars can be weighed and their loads inspected without interference to mill operations, while trucks would have to be handled whenever they arrive. Also, the much smaller quantities trucks would be able to haul would cause congestion at the mills.

Finally, scrap is not an exempt commodity in barge transportation and thus has been subject to relatively high rates by that mode (compared with exempt commodities). Overall, barge movements of ferrous scrap are not significant. In the winter, when the St. Lawrence Seaway is closed, some scrap moves from Chicago to New Orleans by barge for export. The Granite City Works, located on the Mississippi River at Granite City, Ill., is the only integrated steel plant known to be regularly receiving scrap shipments by barge.

The following statistics abstracted from TD-1 are of interest:

Table 3

Transport Characteristics
Iron Ore and Iron & Steel Scrap

	Iron Ore	I&S Scrap
Average length of haul, miles	239	150
Average cars per waybill	70	5
Average lading per car, tons	76	55
Average revenue per car, $	174	246

Some movements of scrap range up to 1,400 miles, significantly longer than the longest ore movements; however, these are some high grades of steel scrap, probably mostly stainless, for which line-haul transportation costs have a lesser effect on total costs than for the lesser grades of scrap.

(51)

Comparative Analysis

Twenty-five movements each of ore and scrap were selected for study based on the common moves criteria. In addition, one supplemental move of iron ore and five of scrap were chosen to make the sample more representative of the national traffic picture for these commodities.

In computing the variable costs of the movements, Rail Form A cost factors for open hoppers were used for the ore moves and gondola cost factors for the scrap moves.

As noted in an earlier chapter, the cost factors for iron ore movements were adjusted to reflect trainload characteristics. Contrarily, cost factors for multiple car operations of scrap were not adjusted. Some reductions in terminal switching and clerical costs per car might be appropriate; however, no reliable adjustment factors are presently available. The effect of these excluded adjustments is some overstatement in scrap variable costs and understatement of contribution.

In assigning rates to the various movements, published rates found to be applicable as the result of a tariff search were used, regardless of the revenue stated in the waybills. In most cases, however, the two figures were reconciled.

Rates shown in the Master Tables (Appendix A) are those used for analytical purposes, and are solely line-haul charges, except that port charges for import movements of iron ore are included where applicable. Ex-Lake rates apply to ore loaded in cars; the handling charge from vessel to car varies by season, volumes and other factors; an average handling charge is customarily applied to the ex-lake ore price, rather than the freight rate. Accessorial charges are not included.

It might be noted that for export shipments of scrap--excluded from this study--in addition to the rail freight charges, shippers also incur a substantial unloading and transfer charge. It is reported to amount to $3.60 per ton when export shipment is via a railroad-owned terminal.

Common Moves

The 25 matched movements of ore and scrap revealed some consistent patterns:

a. Ore loaded heavier than scrap with the exception of only three pairs of movements. In those three exceptions, the scrap loads were 88, 72, and 62 tons--all above the average for that commodity.

b. Without exception, costs per car and per ton were lower for the ore moves. This is due to the major cost characteristics applicable to the ore movements, including the heavier lading and multiple car shipments.

c. Likewise, rates per ton were always lower for ore than scrap. Revenues per car were lower for ore in all but two cases, in which the ore loaded considerably heavier than the scrap.

d. Scrap moves were more profitable for the railroads--in terms of contribution per car--in all but five instances. In those five cases, the ore movements were at least twice as heavy as the matched scrap movements. In three of the cases, the ore cars were three times as heavy as the scrap.

Variances due to length of haul were minimized in this common moves procedure, since the mileage of one move was always within 10 percent of the other.

All Study Moves

These analyses differ from the preceding ones in that emphasis has been placed on all moves selected for study--not just the common ones--and on the derivation of broader, general conclusions.

Taken together, the iron ore moves selected for study have an average lading of 81.3 tons and a range of 460 miles. The scrap moves, on the other hand, have an average load of 55.5 tons per car and a range of 1,316 miles.

Table 4 and accompanying Figure 3 show the behavior of rates and costs over distance. As would be expected, revenues for both ore and scrap rise with distance, while revenues and costs per ton-mile decline over distance.

Rates for the scrap are shown to be consistently higher than those for ore, regardless of distance. In all but one mileage block, the scrap rates (revenues) per ton are at least double those of the ore. This difference can be attributed in part to the higher costs of hauling the scrap, e.g. the diseconomies associated with moving lighter cars and fewer cars at a time. In addition, some of the difference can be laid to other ratemaking factors. The differences in the amount and rate of contribution generated by the two commodities are shown in Table 5 and Figure 4. They reveal two salient facts:

a. The railroads consistently earn a greater contribution per car for scrap than for ore, except for the very short moves; and

b. Contribution as a percent of revenue declines with distance at a greater rate for ore than for scrap.

Table 4

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

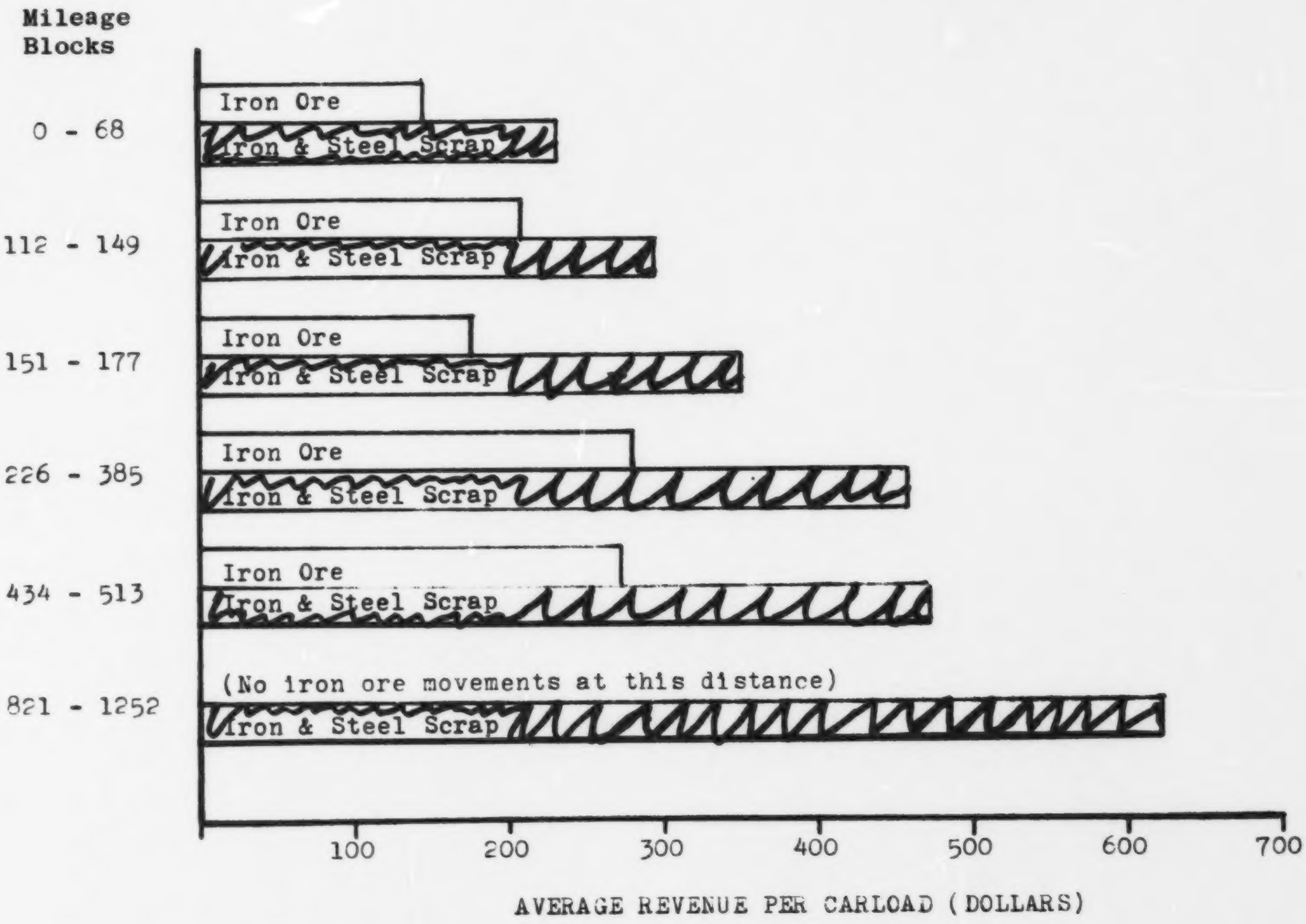
	Virgin Commodity: Iron Ore					Secondary Commodity: Iron & Steel Scrap				
Mileage Blocks	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $
0-68	5	144	1.77	.028	.013	5	228	4.08	.066	.033
112-149	6	209	2.28	.016	.008	4	288	5.46	.042	.020
151-177	6	174	2.28	.014	.008	7	351	6.11	.037	.016
226-385	7	277	3.47	.010	.006	7	461	7.52	.023	.010
434-513	2	272	3.91	.007	.006	3	472	7.05	.015	.008
821-1252	-					4	623	17.43	.016	.010
All Blocks	26	211	2.60	.012	.007	30	398	7.17	.024	.012

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue ÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 3

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF IRON ORE AND IRON AND STEEL SCRAP



Source: Computed from Master Tables, Appendix A.

Table 5

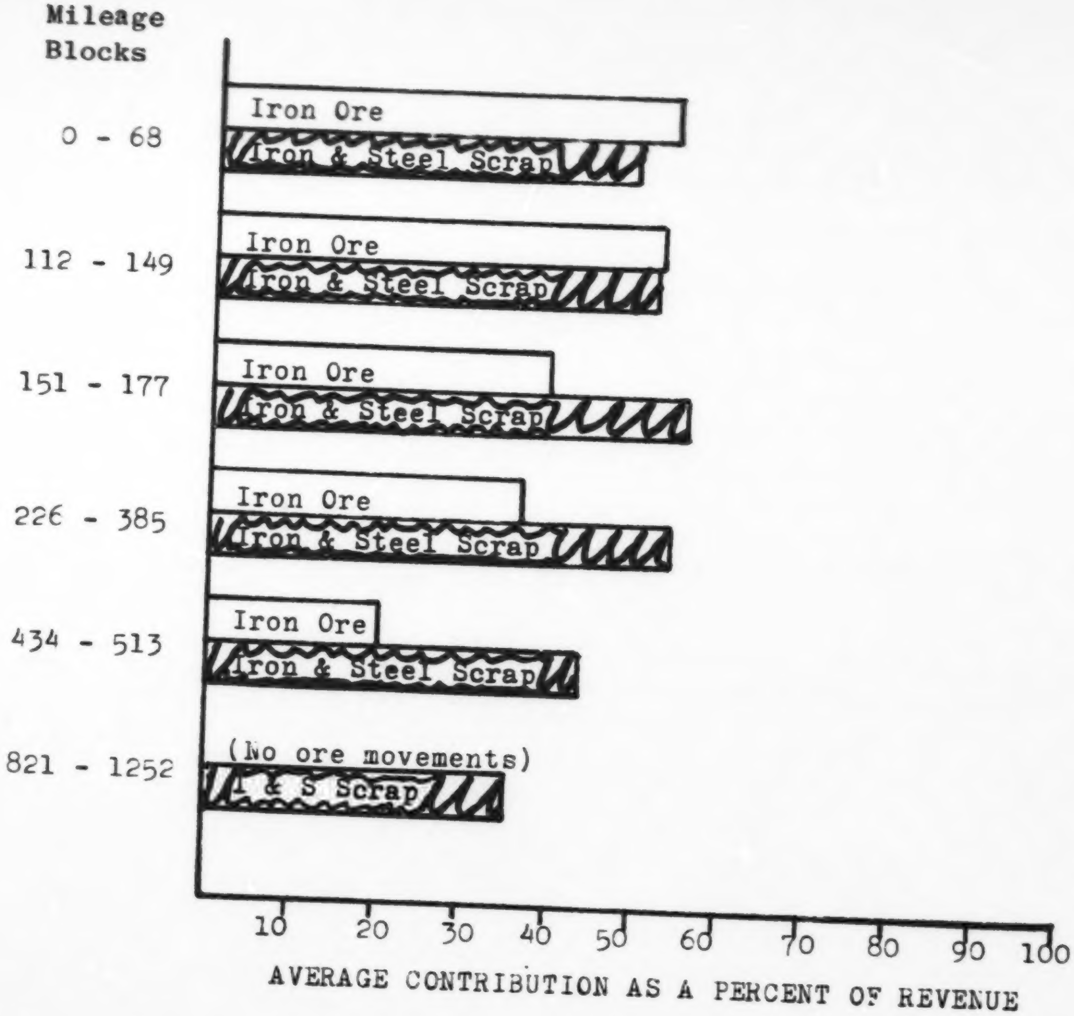
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

Mileage Blocks	Virgin Commodity: Iron Ore			Secondary Commodity: Iron & Steel Scrap		
	No. of Moves	Contrib. Per Car $	Contrib.As % of Rev.	No. of Moves	Contrib. Per Car $	Contrib.As % of Rev.
0-68	5	77.00	53.3	5	112.40	49.3
112-149	6	109.00	52.1	4	149.25	51.8
151-177	6	68.50	39.4	7	197.00	56.1
226-385	7	103.29	37.3	7	255.85	54.6
434-513	2	55.50	20.4	3	207.67	43.9
821-1252	-			4	219.50	35.2
All Blocks	26	87.84	41.5	30	194.33	48.8

Source: Computed from Master Tables, Appendix A.

Figure 4

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF IRON ORE AND IRON AND STEEL SCRAP



Source: Computed from Master Tables, Appendix A.

The behavior of these rates and costs over distance can be summarized as follows:

Mileage Block 1 (to 68 miles)--Revenue per car for scrap is shown to be high relative to ore ($228 compared to $144, a ratio of 1.58), see Table 4. Nevertheless, the cost per car of scrap is even higher relative to ore ($105 compared to $67, a ratio of 1.71). Therefore, even though it appears the carriers are charging considerably more to haul the scrap, they are obtaining slightly more contribution for moving the ore in this mileage block.

Mileage Block 2 (to 149 miles)--Revenue per car for scrap again exceeds revenue for ore, but not as much as in Mileage Block 1. The ratio is now 1.31 ($209 for ore and $288 for scrap). The disparity in cost per car, ore compared with scrap, dwindles even more markedly, to 1.39 ($130 for ore and $139 for scrap). This has the effect of making the contribution percentage closely comparable for the two commodities--52.1 percent of revenue for the ore and 51.8 percent of revenue for the scrap.

Mileage Block 3 (to 177 miles)--Revenue per carload of ore drops slightly in this distance block due to some relatively light cars. Revenue per ton remains as high as in the previous mileage block, however. Revenue per car and per ton of scrap continue to rise. The notable change in this mileage block is that while contribution as a percent of revenue declines again for ore, it actually rises for scrap (to 56.1 percent), so that the contribution rate for scrap now exceeds that for ore.

Subsequent mileage blocks--Even though the ore rates generally rise with distance, costs of hauling the ore rise more, resulting in a lower rate of contribution as distance increases. Contribution as a percent of revenue drops to 20.4 percent in the last mileage block, from a high of 53.3 percent in the first block.

Scrap rates also rise over distance, but at a lesser rate than costs, so that contribution as a percent of revenue declines gradually as distance increases. Nevertheless, the percentage contribution for scrap consistently exceeds that of ore. Even in the last mileage block, scrap rates are contributing an average of 35 percent of revenue.

To illustrate these percentage contribution changes over distance, the actual observations were plotted and lines of best fit were calculated by the least squares method; these representations are shown in Figures 5 [1] and 6.

The line for ore declines at a markedly greater rate than the line for scrap. The equation of the linear regression (Appendix B) shows that the ore line declines at a rate 3.8 times the slope of the scrap line.

Analysis by Destination Territory

A final comparative analysis was done to identify rate differences by destination territory. Its purpose is to show what consignees actually paid for transportation on average, and reflects differences of location, relative distances from material sources, and, of course, rate differences between ore and scrap. The entire waybill data file was used for this analysis, since there was no need to relate the data to operating costs, which, of course, are not contained in the data file. The data are summarized in Table 6.

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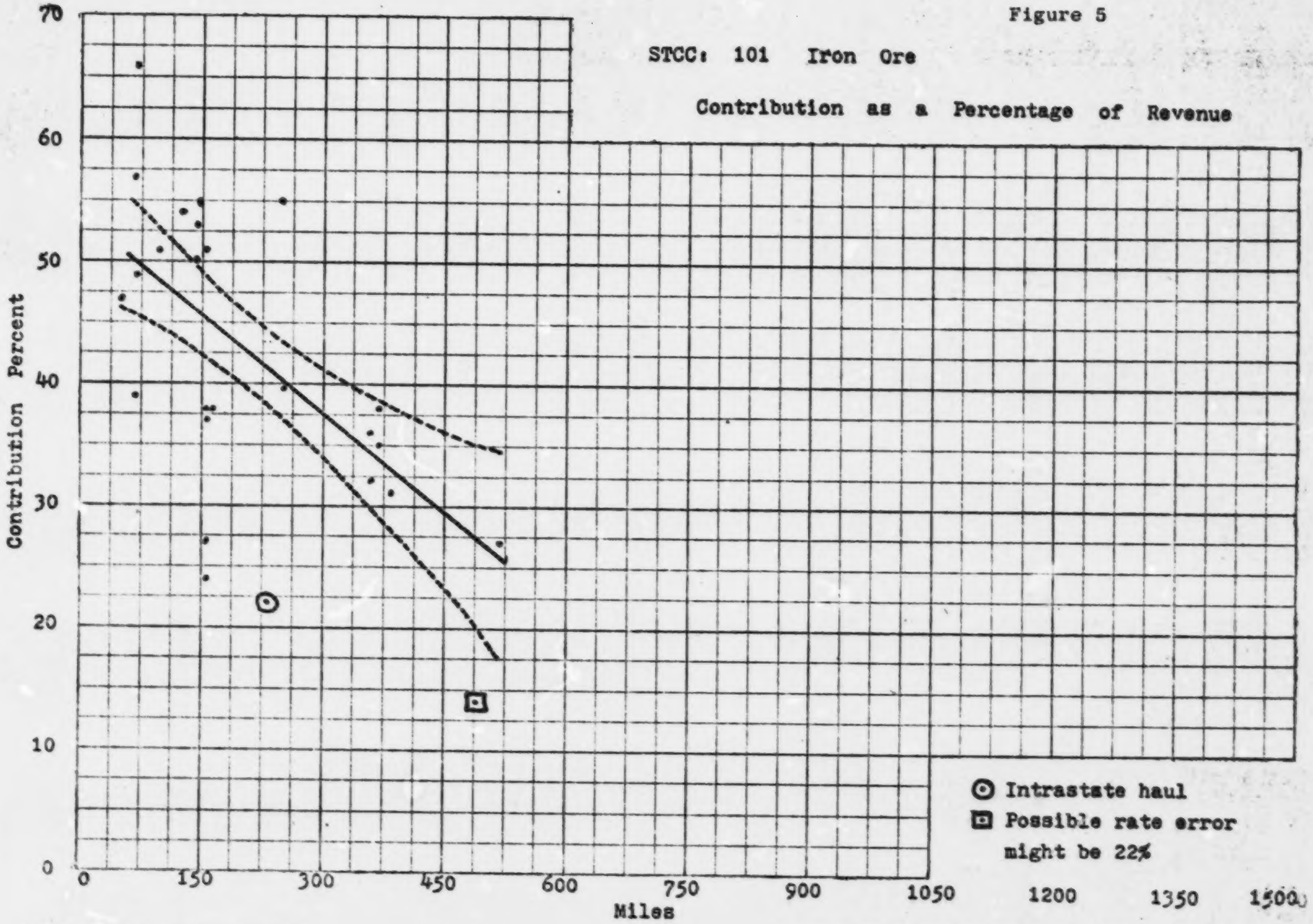
[1] Solid line depicts line of best fit, broken lines show confidence bands.

Figure 5

STCC: 101 Iron Ore

Contribution as a Percentage of Revenue



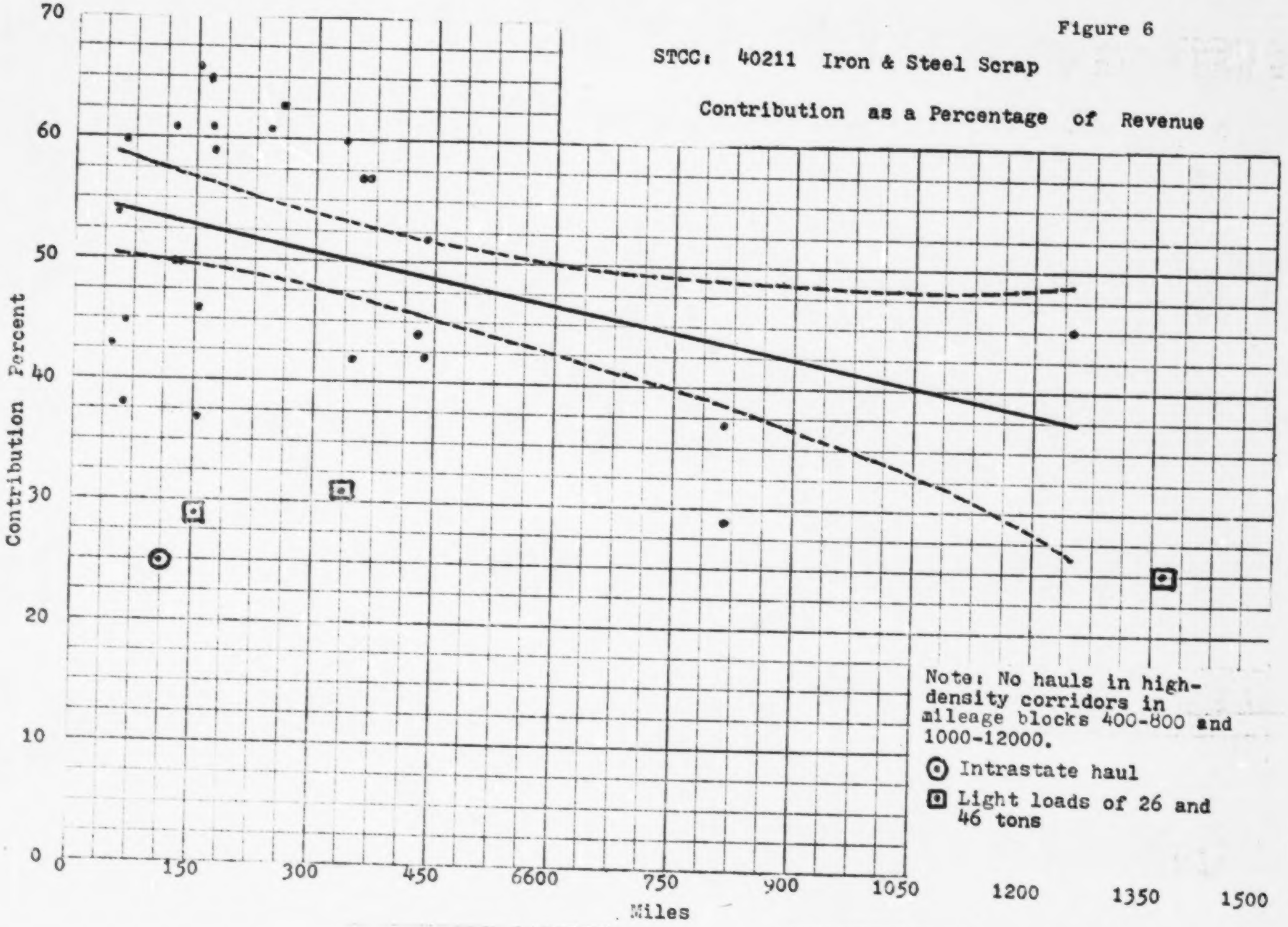


Figure 6

STCC: 40211 Iron & Steel Scrap

Contribution as a Percentage of Revenue

Note: No hauls in high-density corridors in mileage blocks 400-800 and 1000-12000.

TABLE 6

Rate Differences By Destination Territory, Iron Ore and Iron & Steel Scrap

	IRON ORE			I&S SCRAP		
Dest. Terr.[1]	Avg.Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile	Avg.Rev. Per Ton	Avg. Haul (mi.)	Avg.Rev. Per Ton-Mile
1	$2.33	200	1.19¢	$4.24	110	3.69¢
2.	2.39	216	1.13¢	4.95	184	2.54¢
3	2.22	255	0.86¢	5.13	253	2.10¢
4	3.46	310	1.11¢	6.71	392	1.91¢
5	2.56	246	1.07¢	4.35	207	2.11¢

[1] See Figure 1 for description of territories.

This table confirms the point made earlier that scrap rates are consistently higher than ore rates, the ratio of scrap rates per ton to ore rates ranging from a low of 1.7 in Territory 5 to a high of 2.3 in Territory 3, and a mean of almost twice the amount per ton of scrap as compared with ore.

The comparison of revenue per ton-mile must take in consideration the distance of the average haul (though, of course, the rate analyses have considered this element also). The pattern here, as shown in Table 6 is quite uneven for ore, and more consistent for scrap. The lowest revenue per ton-mile for ore, 0.86¢ in Territory 3, reflects an average distance of 255 miles, about the same distance as in Territory 5, for which a 24 percent higher ton-mile revenue is shown. The highest ton-mile revenue is in Territory 1 which indeed also has the shortest average haul. For scrap, the highest ton-mile revenue is almost three times the lowest figure. The latter applies to the longest average haul, and the former to the shortest; this is consistent with variable cost characteristics.

Findings

Before summarizing the findings cited in the previous sections and stating some conclusions, it should be emphasized that the findings herein are based on a subsample of a sample of railroad waybills, and that the totals and averages in this report do not necessarily agree with comparable figures in the Department of Transportation's so-called "Burden Study".[1/] Different methods of research account for the variances.

Costs considered, it appears that the rate levels for ore and iron and steel scrap are not depressed and, in fact, may be unduly high for scrap, as shown by the relative contribution percentiles.

For the movements selected for study, ore revenues amounted to 171 percent of variable costs, while scrap revenues totaled 196 percent of variable costs. (The complete figures in the 1969 Burden Study, reflecting all sampled movements, are 130 percent and 142 percent, respectively.) Thus, the average contribution for the scrap was almost equal the average variable cost. Fixed costs being less than variable costs, the rates of contribution developed in this study undoubtedly gave the carriers a return on investment. The scrap contribution rate is 35 percent higher than that for ore (96 percent as compared with 71 percent). For multiple car shipments of scrap, actual costs might well be considerably lower than those calculated and correspondingly the contribution rate would be even higher. No doubt the most clearly documented differences in relationship relate to the rates over longer distances, where the scrap contribution stays high while the ore contribution declines.

[1/] An Estimation of the Distribution of the Rail Revenue Contribution by Commodity Groups and Type of Rail Car, 1969, Department of Transportation, September, 1972.

The railroads' treatment of rates over distance seems more equitable and rational for iron ore than for scrap. Revenues per ton-mile for study movements of ore were high for short moves (2.8 cents on average). Ton-mile revenues then dropped progressively as mileage increased, so that succeeding mileage blocks had averages of 1.6 cents, 1.4 cents, 1.0 cents, and .7 cents. Revenue per ton-mile for the scrap dropped sharply in the second and third mileage blocks, but rose slightly for the longest moves; no cost related justification was found to explain this pattern.

Though this rate structure reflects a declining contribution as a percent of revenue as distance increases for both ore and scrap movements, their rates of decline are quite dissimilar. The contribution rate for the ore rates dropped at an average of 5.3 percent per 100 miles over distance, while it declined at a rate of only 1.4 percent for scrap. The railroads, in short, are keeping the rates higher for scrap than ore. Put differently, while for ore there is an apparent reflection in the ratemaking of the fixed terminal cost and the line haul per mile cost, such is not the case for scrap iron. Quite clearly, the declining variable costs per mile over increased distance are not reflected in scrap rates in nearly the same manner as they are in the ore rates.

The study provides no evidence that the carriers are pricing in such a way as to differentiate unfairly against receivers in any particular region, for either ore or scrap.

This analysis varies somewhat from that of the I.C.C., as expressed in its report in Ex Parte 281 of September 27, 1972, and its supplemental Final Environmental Impact

Statement. Citing 1969 Burden Study figures, the Commission pointed out that in Official Territory (Official to Official traffic) iron ore produced a higher ratio of revenue to variable costs (143.1) than iron and steel scrap did (137.8). Yet the reverse was true for the entire nationwide sample (U.S. to U.S. traffic in the Burden Study). Those figures show a revenue to variable cost ratio of 142.1 for scrap and 130.0 for ore.

The Commission also analyzes revenue per car (see page 51, Final Environmental Impact Statement), using merely historic average revenue per hundredweight and car. This is a highly misleading indicator when presented without relevance to costs and distance of haul. Indeed, we have recognized the importance of the indicator "revenue per car" and have focused on it in several of our statistical tables, but never without relating it to a complementary indicator or factor. As a general guide, a line haul move not generating $70 per car is not an attractive move, on average, for any Class I railroad (it may be attractive for a short line carrier or as a switch move), because it does little more than cover terminal and clerical costs. But how much more attractive is a scrap car with a billing of $231 as compared with an ore car producing revenue of $174 can only be shown by relating these figures to the costs of the traffic. In fact, the I.C.C. statement fails to provide any answer to the question: to what extent, if any, is the 29 percent greater revenue for the scrap car absorbed by greater costs for that average move as compared with the average ore move?

Our findings have, we believe, answered the foregoing question.

In conclusion, emphasis should be placed on the movements in the first three mileage blocks, since that is where the bulk of the traffic is. Approximately 77 percent of the ore movements and 76 percent of the scrap movements in the Waybill Sample were less than 200 miles in length.

Looking only at this "short-haul" traffic, the rates for scrap are considerably higher than for ore. As noted previously in 1.4.2. the difference in rates would appear cost justified. However, while the service cost calculations for the ore movements are "adjusted" to reflect the peculiar characteristics of that traffic, those for scrap movements, regrettably, are not comparably modified due to lack of information. It would be hazardous to speculate what effects appropriate cost factor modifications would have on the contribution rates for these "short haul" scrap movements. One factor often mentioned by the carriers is higher than average repair costs for gondola cars used in ferrous scrap service. If indeed it is the case--a contention vigorously refuted by industry traffic men--it may be more than compensated for by the use of relatively old cars for which the fixed charges are lower than the average contained in the RFA formula.

An informed estimate tends to suggest that the contribution rate of 53.3 percent for scrap, as compared with the 48 percent rate for ore, in this distance range to be understated. Just how much greater the contribution to fixed costs and profit might in fact be, as noted, could not be ascertained in this study and any quantification of this informed estimate would indeed be speculative.

As noted at the outset of this subchapter, carriers by railroad are the most significant transport mode for the industry and commodities subjected to study here. Consequently, our analyses were limited to movements by rail. It should be remembered, however, that quite recently concern has been expressed by scrap industry representatives over proposed general increases in the freight rates of common carrier barge lines for iron and steel scrap (see I&S Docket No. 8753, I.C.C., Verified Statement of Dr. Herschel Cutler, Executive Director, Institute of Scrap Iron and Steel, Inc.). Two important contentions were expressed. First, iron ore is an exempt commodity, e.g. the transportation thereof by barge is not subject to rate regulation, and therefore it is not affected by any general rate increase applicable to regulated commodities, including scrap; second, that the proposed increase will further widen the already existing gap in ore and scrap rates to the detriment of the latter.

According to I.C.C. rules and precedent the comparison of regulated and unregulated traffic is inadmissible; moreover, such comparisons can rarely, if ever, result in documented and defensible findings, because no public record exists for the charges levied by carriers of exempt commodities, such as the tariff published by an agent in behalf of the rate maker. Nonetheless, a small sample of information furnished us by shippers on a confidential basis suggests tha from a cost viewpoint, a situation somewhat similar to that attending the average rail hauls may exist. The few figures examined by us suggest that rates charged for the movement of scrap in barge loads of less than 1,000 tons are twice or more the negotiated rates for ore; further, barge load revenues for scrap, though they carry on average between 50 percent and 70 percent the ore tonnage, are higher for the secondary commodity than for the virgin material. Contrariwise, the equipment cost for the scrap shipments is typically lower as older and smaller barges are being utilized for that commodity.

Though we are unable to present definitive findings in this regard, it does appear as if barge rates for scrap shipments are indeed high and may quite seriously inhibit the greater utilization of this low cost mode of transport for scrap shipmentsover routes for which waterborne movements are otherwise advantageous.

Paperboard Industry

Introduction

The paperboard industry, SIC 2631, was chosen for study because it consumes large quantities of waste paper in addition to virgin fiber. Paperboard mills produce a diversity of paper board products, including milk carton and paper plate stock, corrugating board, liner board, combination paperboard, and cardboard tubing.

Post's Pulp & Paper Dictionary for 1972 listed 255 mills that make one or more types of paperboard. The mills are located in 39 States, with concentrations in the Far West, Upper Midwest and East. While there are relatively few mills in the South, they tend to be larger than those in other parts of the country. Ohio, for instance, was reported to have 21 mills with 4.8 percent of the industry's production capacity, but Alabama, with only seven mills, had about 5.2 percent of the industry's capacity.

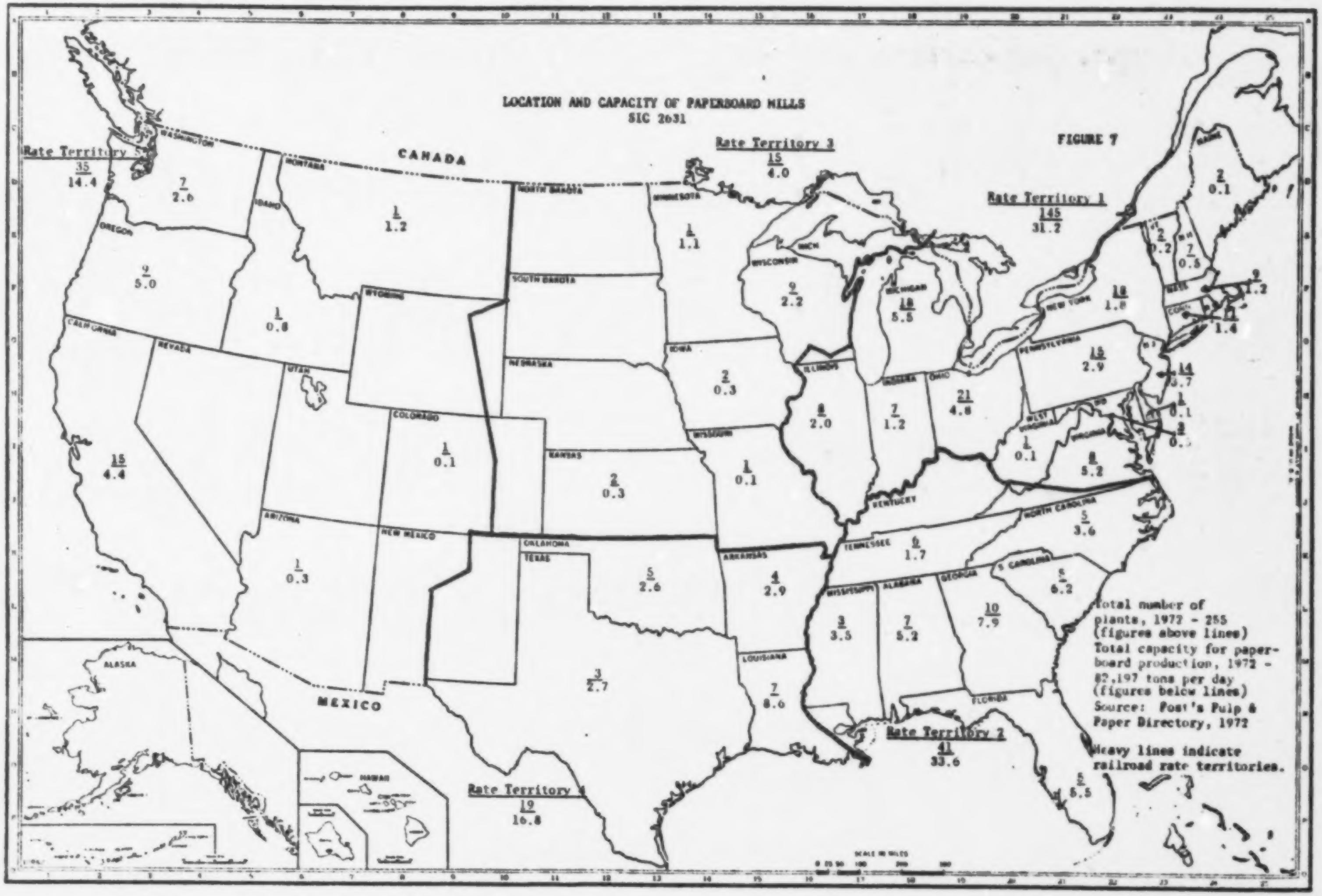
The number of mills in each state and the percentage of total industry capacity contained in each state are shown in Figure 7. This map also shows distribution of mills and production capacities by railroad rate territories. While Official Territory has the largest number of mills, 145, Southern Territory contains the largest share of production capacity, 33.6 percent of the national total.

According to the Census of Manufactures for 1967, the value of market shipments (excluding interplant transfers) from paperboard mills was $1.9 billion.

The mills consumed about 16 million tons of pulp and about eight million tons of waste paper that year, producing about 22 million tons of board. Conceivably, capacity figures

LOCATION AND CAPACITY OF PAPERBOARD MILLS
SIC 2631

FIGURE 7


CANADA
MEXICO
Rate Territory 5
35
14.4
Rate Territory 3
15
4.0
Rate Territory 1
145
31.2
Rate Territory 4
19
16.8
Rate Territory 2
41
33.6
WASHINGTON 7 2.6
OREGON 9 5.0
CALIFORNIA 15 4.4
IDAHO 1 0.8
MONTANA 1 1.2
COLORADO 1 0.1
ARIZONA 1 0.3
KANSAS 2 0.3
OKLAHOMA 5 2.6
TEXAS 3 2.7
MINNESOTA 1 1.1
IOWA 2 0.3
MISSOURI 1 0.1
ARKANSAS 4 2.9
LOUISIANA 7 8.6
WISCONSIN 9 2.2
ILLINOIS 8 2.0
MICHIGAN 18 5.5
INDIANA 7 1.2
OHIO 21 4.8
KENTUCKY
TENNESSEE 6 1.7
MISSISSIPPI 3 3.5
ALABAMA 7 5.2
GEORGIA 10 7.9
FLORIDA 5 5.5
S CAROLINA 5 6.2
NORTH CAROLINA 5 3.6
VIRGINIA 8 5.2
WEST VIRGINIA 1 0.1
PENNSYLVANIA 15 2.9
NEW YORK 18 1.8
MAINE 2 0.1
VT 2 0.2
NH 7 0.5
MASS 9 1.2
CONN 11 1.4
NJ 14 3.7
1 0.1
3 0.3
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
NEVADA
UTAH
NEW MEXICO
ALASKA
HAWAII
SCALE IN MILES

Total number of plants, 1972 - 255 (figures above lines)
Total capacity for paperboard production, 1972 - 82,197 tons per day (figures below lines)
Source: Post's Pulp & Paper Directory, 1972

Heavy lines indicate railroad rate territories.

shown in Figure 7 may be understated (82.197 tons/day x 2660 = 21.4 million); this may be due to most mills having also capacity to produce other paper grades, and the figures reported by them do not accurately divide installed capacity between their various production lines.

The Commodities

Woodpulp and waste paper were chosen as the virgin and secondary commodities, respectively, for study in the paperboard industry.

Pulp is manufactured from logs or wood chips by several chemical or mechanical processes. The fibrous material obtained from these processes can be utilized almost completely in making all types of paper products, including paperboard.

About 38 million tons of pulp were used by all types of consumers in 1967, according to Census data, and all but one million tons were used in the primary production of paper; as noted, paperboard mills consumed almost 16 million tons, or 42 percent of total consumption.

"Waste paper" as used in this report refers solely to conversion wastes (material discarded in the production of finished paper products, including paperboard) and obsolete paper, e.g. paper and paper products which have served an end-product purpose before. It does not refer to scrap generated and consumed in the primary production of paper. This internal scrap, or "broke" as the industry calls it, is not included in industry or Census data.

Waste paper that has been sorted and graded to meet the specifications of consuming industries is called paper stock. Five broad categories of paper stock are recognized, each of which includes several specific grades. The categories are as follows, listed with 1969 consumption figures by all U.S. mills:

TABLE 7
Paper Stock Consumption By Type

Paper Stock Category	Consumption (1,000 tons)	Percent Of Total
1. Mixed	2,609	21.8
2. News	2,171	18.1
3. Container	4,416	36.9
4. Pulp Substitutes	1,952	16.3
5. De-inking	821	6.9

Source: "Tappi," Vol. 55, No. 11 (November, 1972), p. 1606.

The paperboard industry consumed 8.6 million tons of paper stock in 1969, about 72 percent of all paper stock consumed in the United States that year.[1/] It used a greater percentage of container grades and a lower percentage of pulp substitutes and de-inking grades than the paper industry as a whole.

Paper stock is usually purchased at a seller's shipping point price. The paperboard mills thus assume the burden of transportation costs. However, dealers are selling on a delivered basis, transporting the waste product in their own vehicles.

The mills may buy either from a dealer-processor, or directly from a converter or a commercial trash collector. In the past two or three years, reclamation centers operated by civic and environmental groups have been collecting

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[1/] "Tappi," Vol. 55, No. 11 (November, 1972), p. 1607.

significant quantities of waste paper, mostly news grades, and selling it to dealers or directly to mills.

Transport Characteristics

Relatively little pulp moves in interstate commerce. The usual distribution pattern is for logs and chips to be transported from forests to pulp mills which are usually located at the same site as a paper mill. After the wood is reduced to pulp, it is transported intraplant to the paper mill. The 1967 Census data showed that only 2.2 percent of the pulp consumed by paperboard mills was purchased from outside sources; 93.8 percent was produced by the paperboard manufacturers on site, and the other 4.0 percent was produced on site by affiliated mills.

The pulp that does move by for-hire carriers moves overwhelmingly by rail. In 1969, barge lines transported about 800,000 tons of pulp, Class I common and contract motor carriers transported 191,000 tons, and the railroads hauled 8.4 million tons--usually in bales, in boxcars.

While very little pulp moves by regulated motor carriers, the proportion of paper stock moving to board mills by regulated contract motor carriers has increased in recent years. Common motor carriers of general commodities do not participate, except infrequently, in this traffic. Significant waste paper movements from collection points to consuming mills are also performed by private trucks, operated by scrap paper dealers and the board mills. In 1969, however, freight commodity statistics published by the I.C.C. show only 17,358 tons as having been carried by regulated motor carriers.

The following characteristics apply to the rail moves of woodpulp and waste paper shown in TD-1:

TABLE 8
Transport Characteristics
Woodpulp & Waste Paper

	Woodpulp	Waste Paper
Average load per car, tons	58	34
Average length of haul, miles	871	333
Average revenue per car, $	663	247

On average, the waste paper moves were 62 percent shorter and 41 percent lighter than the pulp moves.

Common carrier truckers of general commodities are disinterested in this commodity because of prevailing rate levels by rail and contract carriers. The peculiar characteristics of this traffic are also a disincentive--including inordinately long loading and unloading periods, relatively light ladings and day-to-day variations in origin and destination points, thereby precluding reliable advance scheduling of equipment.

As would be expected, waste paper hauls by truck are mostly over short distances, though hauls of up to several hundred miles are not uncommon. The average distance is a function of the consuming plant's location relative to urban centers, the main source of this secondary commodity.

Ladings per truckload vary by the type of paper stock transported and the preparation facilities available to the shipper. Average ladings are in the 15 to 18 ton range, with lightest loads around 10 tons, and the heaviest up to vehicle capacity and/or legal limits, generally not in excess of 21 tons. The rate structure is mostly based on 16 ton minimum truckloads or on 10 ton minima and incentive rates for ladings above that quantity.

The attractiveness of waste paper carriage for contract and private carriage is exclusively in the avoidance of empty backhauls to the plants, from which higher rated paper products are secured by these carriers.

Comparative Analysis

The selection process for common moves by rail produced 32 pairs for study. The addition of supplemental moves brought the sample size to 48 pulp movements and 42 waste paper movements. Average loads for these moves were about the same as those contained in the Waybill sample; the study moves reflect a distance range for woodpulp in excess of 2,400 miles and for waste paper of more than 1,600 miles. Average revenue per car was $535 for pulp (as compared with $663 in the Waybill sample), and $275 for paper stock (as compared with $247 in the larger sample).

The pulp moves ranged in weight from 30 to 96 tons, with a mean of 59.5 tons. The waste paper moves were much lighter, ranging from 20 to 65 tons and averaging 37 tons. (It is to be noted that density of waste paper loads depends in large measure on the shippers' baling equipment; to produce highly compacted bales, relatively expensive equipment is needed. The economics attending to the deployment of such hardware has been questioned by industry experts. Prevailing opinion indicates that of current prices for waste paper, expensive preparation processes entailing the use of elaborate capital equipment is only marginally profitable.)

Rates used for the analysis were obtained from a search of published tariffs; in most cases, these rates reconciled with the revenues shown in the waybill records.

In determining variable costs for the moves, Rail Form A cost factors for boxcars were used for both the pulp and waste paper traffic.

Common Moves

The common moves selected for study included two perfect matches; i.e. the origin and destination stations were identical for both products. Both pairs consisted of Wisconsin intrastate moves. One pair was from Appleton to Stevens Point, a distance of 64 miles, and the other was from Appleton to Neenah Menasha, only five miles. While the second pair of moves appear to be switch moves and not typical of the traffic being analyzed, the Appleton-Stevens Point moves deserve a close examination.

The moves had similar ladings, 49 tons for the pulp and 43 for the paper. They moved in the same type of cars and their rates were published by the same tariff bureau. This pair thus provides an uncommon opportunity to compare moves of almost identical characteristics for two competing commodities.

Due to the heavier lading, the cost per car was slightly higher (two percent) for the pulp than the paper. Dividing those car costs by the different ladings produced a cost of $2.05 per ton for the pulp and $2.30 for the paper. The rate was also higher for the paper--$3.00 as compared with $2.60. However, the heavier load of pulp produced almost as much revenue per car as the paper shipment. The waste paper move produced a somewhat higher contribution, both per car and per ton, since its rates were higher and its costs were about the same as the pulp move. The contribution made by paper was 23 percent of revenue and that by the pulp was 20 percent of revenue.

The common moves include 14 Maine intrastate movements of pulp. Most of these moves took per-car rates published by the Maine Central Railroad which produced relatively low rates per ton. All 14 had lower rates than the waste paper moves paired with them, sometimes amounting only to 25 percent of the waste paper rates. Some of these pulp moves made no contribution at all, on the basis of average costs, and with the exception of only one, made less contribution per car and per ton than their waste paper counterparts.

Turning to the other 18 common moves, it can be seen that with only three exceptions, the pulp moves produced more contribution per car and per ton for the railroads than the waste paper moves. One of these exceptions was the perfect match cited above (Appleton to Stevens Point, Wis.). The other two were pairs in which the waste paper moves were light (20 and 22 tons) and took exceptionally high rates.

All Study Moves

These analyses deal with the entire sample of moves, rather than just the common ones, thus permitting judgments about the woodpulp and waste paper traffic as a whole.

Table 9 shows the behavior of rates and costs for the competing commodities over distance; Figure 8 depicts the carload revenues for both commodities. Some discernible patterns emerge from this Table and Figure:

a. The average revenue per car and per ton rise with distance in a consistent manner for both woodpulp and waste paper.

b. The average revenue per ton-mile and variable cost per ton-mile generally decrease with distance in a fairly consistent manner for both commodities. Contrary observations can be seen in the 201 to 400 mileage block for pulp and the 1501 to 2000 mileage block for waste paper.

Table 9

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

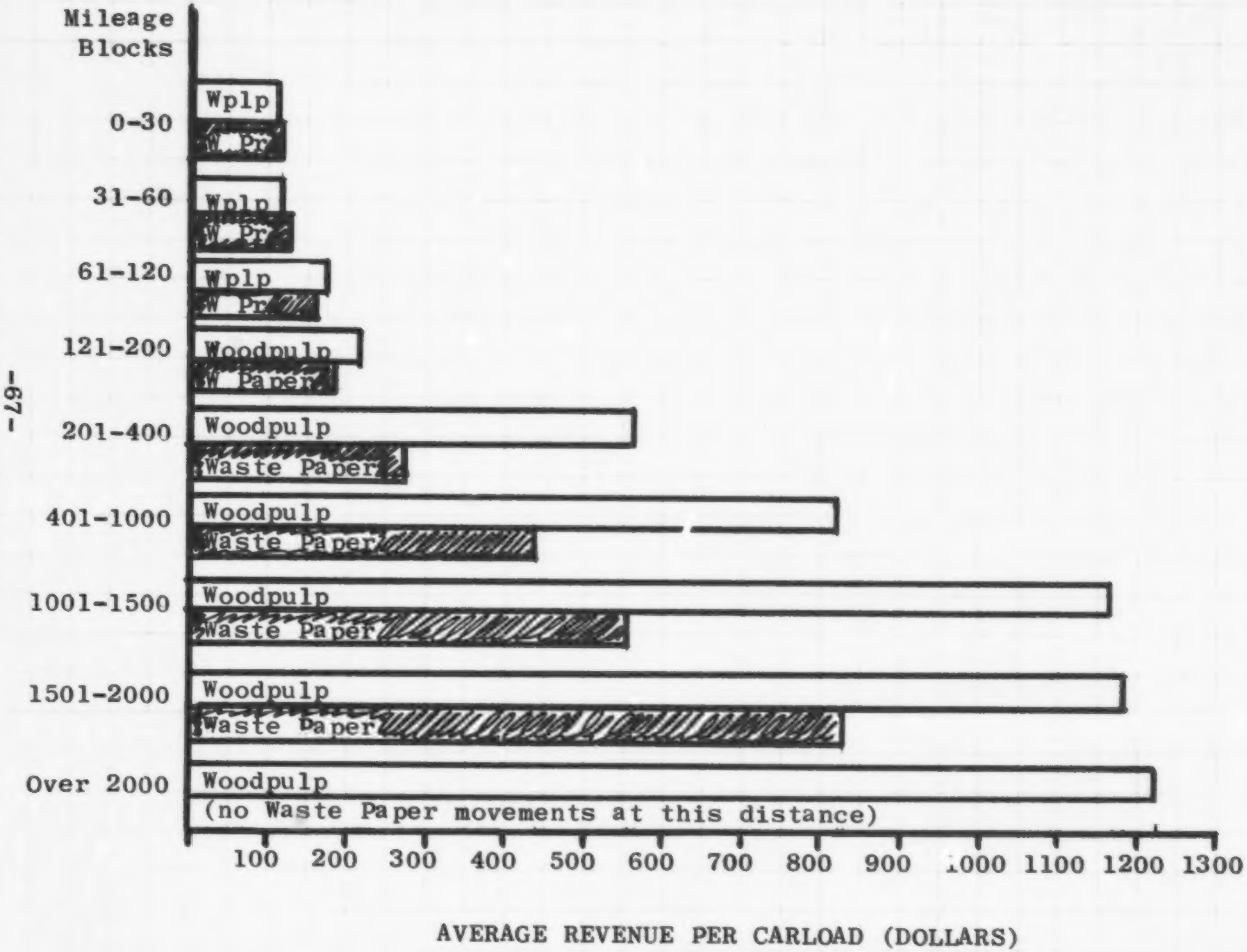
	Virgin Commodity: Woodpulp					Secondary Commodity: Waste Paper				
Mileage Blocks	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $
0-30	5	111	2.03	.105	.092	5	112	3.33	.185	.159
31-60	6	112	2.03	.041	.041	6	119	3.95	.082	.062
61-120	6	176	3.23	.034	.025	6	158	4.46	.049	.035
121-200	9	217	3.65	.025	.018	9	185	5.31	.037	.026
201-400	4	561	9.47	.028	.012	4	274	7.84	.023	.016
401-1000	6	821	12.96	.018	.006	6	446	9.84	.014	.009
1001-1500	6	1170	17.25	.013	.005	4	556	12.92	.010	.007
1501-2000	2	1188	19.01	.010	.005	2	823	17.70	.010	.006
Over 2000	4	1224	20.23	.009	.005	-	-	-	-	-
All Blocks	48	535	9.00	.014	.007	42	275	7.43	.017	.011

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue ÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 8

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF WOODPULP AND WASTE PAPER



Source: Computed from Master Tables, Appendix A

c. With the exception of mileage blocks 1 and 2, to 30 miles and 60 miles respectively, which are influenced by the Maine intrastate pulp movements' low rates, the revenue per car is greater for pulp than waste paper.

d. For moves of up to 200 miles, the average revenue per ton is greater for waste paper than pulp--again a result of depressed intrastate rates on pulp. For moves that exceed 200 miles, the situation is reversed, with pulp taking the higher rates. Pulp rates for the longest moves in the sample average $20.30. For the 1,501 to 2,000 mile distance block, the last one in which there are both pulp and paper movements, the average rate per ton for pulp is $19.01, about seven percent higher than for paper.

The effect that these rates and calculated variable costs have on contribution is shown in Table 10 and Figure 9.

The amount of contribution per car produced by woodpulp is erratic over distance. Contribution starts at a low level ($13.60), drops practically to zero in the second mileage block (31 to 60), rises steadily in the third through seventh mileage blocks (61 to 1,500), then declines in the last two mileage blocks. The same pattern is repeated for the contribution as a percentage of revenue, as seen in Figure 9, contrary to the normal downward sloping contribution trends that apply to most commodities.

The 31 to 60 mile block, in which average contribution per car of woodpulp is 33 cents, contains six movements. Three are Maine intrastate movements which, as noted previously, have uncommonly low rates. The other three moves are hauls

Table 10

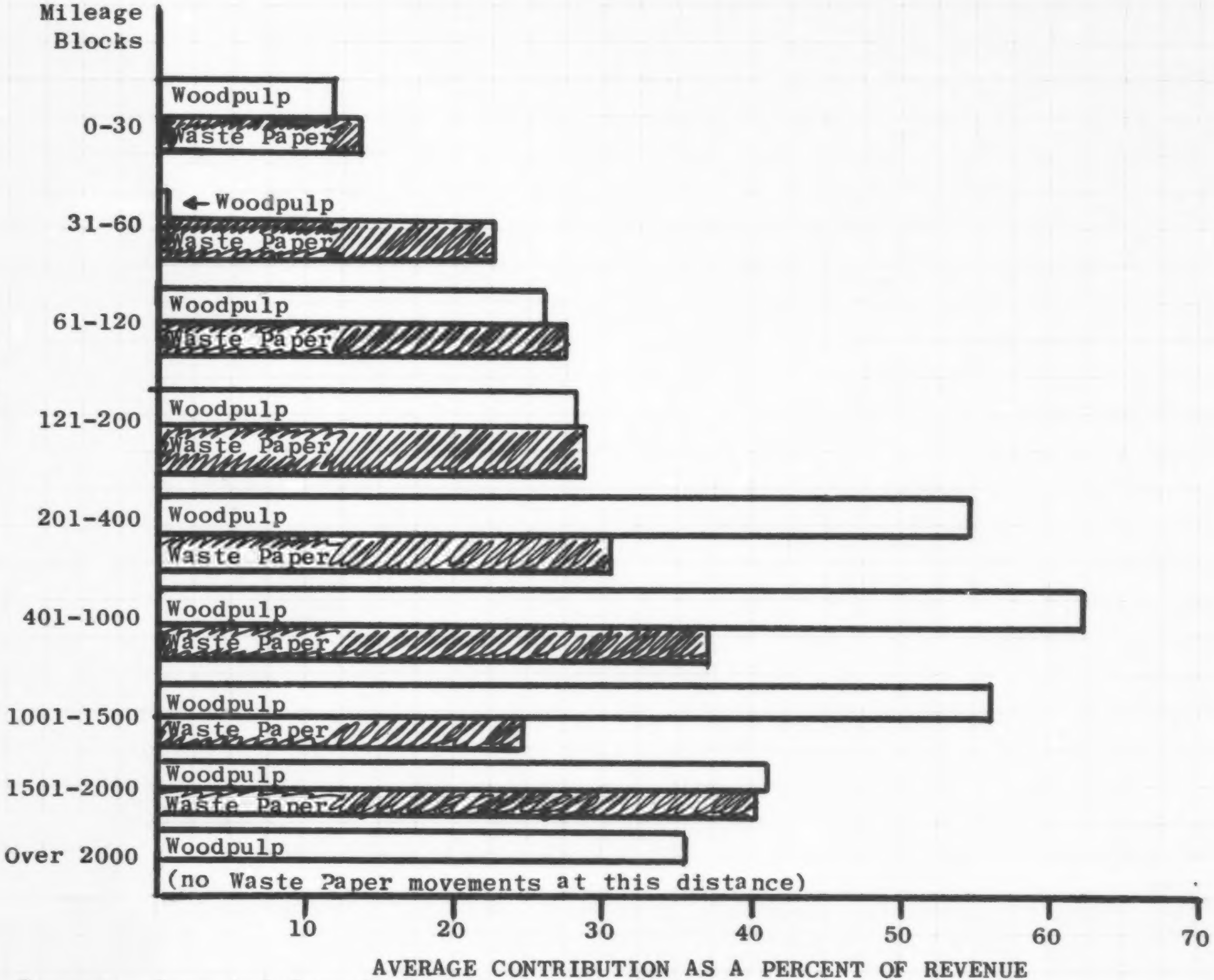
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

Mileage Blocks	Virgin Commodity: Woodpulp			Secondary Commodity: Waste Paper		
	No. of Moves	Contrib. Per Car $	Contrib. As % of Rev.	No. of Moves	Contrib. Per Car $	Contrib. As % of Rev.
0-30	5	13.60	12.2	5	15.60	13.9
31-60	6	.33	0.2	6	27.33	22.9
61-120	6	46.33	26.2	6	43.50	27.5
121-200	9	61.00	28.1	9	53.78	29.0
201-400	4	308.00	54.9	4	83.25	30.3
401-1000	6	512.67	62.4	6	165.67	37.1
1001-1500	6	661.67	56.5	4	137.75	24.7
1501-2000	2	501.00	42.1	2	331.00	40.2
Over 2000	4	442.75	36.1	-	-	-
All Blocks	48	248.92	46.5	42	83.98	30.5

Source: Computed from Master Tables, Appendix A.

Figure 9

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF WOODPULP AND WASTE PAPER



Source: Computed from Master Tables, Appendix A

between Green Bay, Wis. and Menominee, Mich.; the low rates for those moves might reflect non-cost related considerations.

Contribution as a percent of woodpulp revenue appears to be high in the mileage blocks encompassing the range of 200 to 1,500 miles, and especially so for the 1,000 to 1,500 mile range, where the percentage is 56.6. Waste paper movements in that mileage block had a contribution rate of less than half as much--24.7 percent.

The contribution pattern for waste paper is somewhat less erratic than for pulp. As Figure 9 illustrates, the contribution rate starts relatively low, climbs gradually as the lengths of haul approach 1,000 miles, drops for moves in the 1,000 to 1,500 mile range, and then jumps again for the longest moves. For the longest waste paper moves, the percentage contribution rate is 40, just slightly less than for comparable pulp moves.

In the mileage range of up to 200 miles, it appears that the carriers earn about the same amounts per car for both commodities. In the range of 201 to 1,500 miles, the carriers receive considerably more contribution per car on pulp than paper. For the longest moves, there seems to be a close parity again.

Using a regression equation, lines of best fit were drawn for observations of contribution as a percentage of revenue, for both pulp and paper (Figures 10 and 11). The slope for pulp drops at a rate of about one percentage point per 100 miles, while the slope for waste paper drops at a somewhat greater rate, 1.7 points per 100 miles.

Figure 10

STCC: 26111 Woodpulp
Contribution as a Percentage
of Revenue

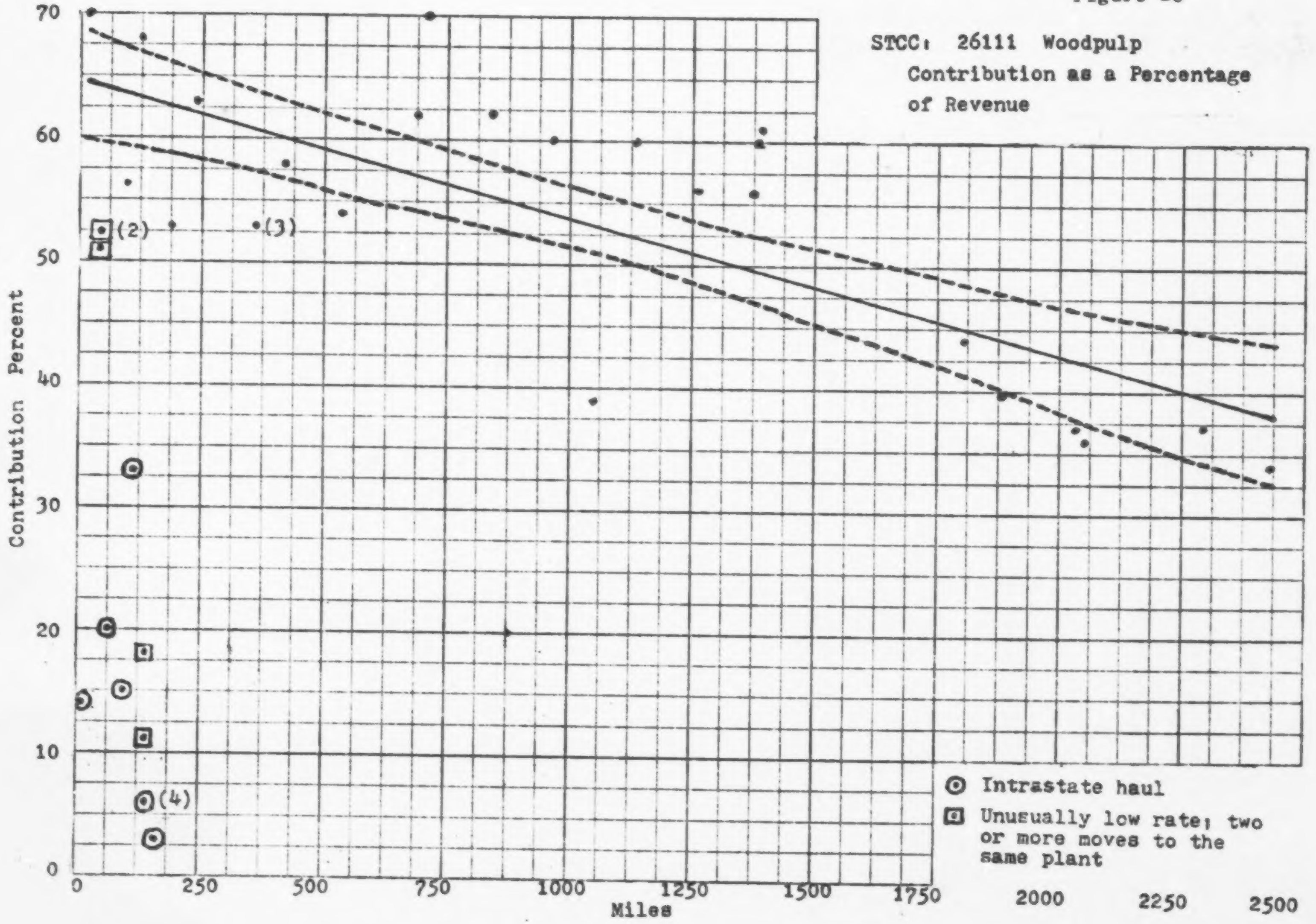
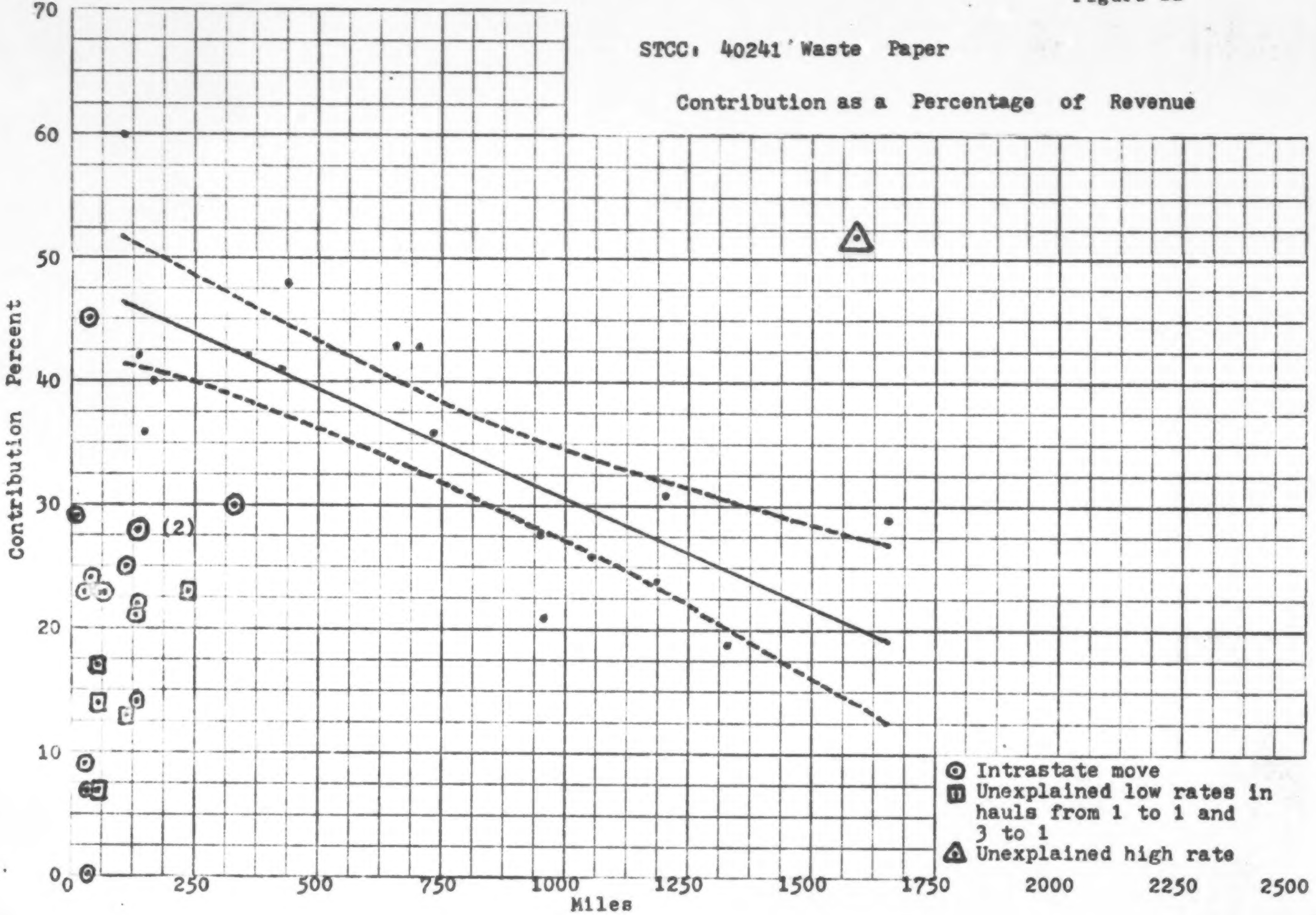


Figure 11

STCC: 40241 Waste Paper

Contribution as a Percentage of Revenue



One reason for the depressed contribution figures for the short moves of both pulp and paper is contract and private motor carrier competition. Service offered mainly by contract motor carriers keeps the rail rates relatively low for distances up to 300 miles.

Analysis By Destination Territory

This analysis illustrates the differences in amounts paid by paperboard mills relative to their location. The following table, based on all moves in the 1969 One Percent Waybill file, shows rail freight transportation costs by destination territory.

TABLE 11
Rate Differences By Destination Territory
Woodpulp and Waste Paper

	WOODPULP			WASTE PAPER		
Dest. Terr.	Avg.Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile	Avg.Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile
1	$13.35	1,059	1.22¢	$7.30	292	2.27¢
2	8.41	552	1.58¢	5.90	319	1.80¢
3	12.91	1,056	1.19¢	8.82	473	1.64¢
4	6.31	529	1.37¢	7.20	367	1.84¢
5	12.83	1,065	1.18¢	7.91	421	1.66¢

Receivers of woodpulp in destination territories 1, 3, and 5 appear to be situated about the same average distance from supply sources, and they are paying about the same amounts, both in absolute and ton-mile terms. Woodpulp consignees in Territory 2 are located, on average, the same distance from markets as those in Territory 4, but they are paying substantially higher rates.

Buyers of rail transportation for waste paper appear to be receiving about equal treatment, on average; consignees in destination territory 1, Official, are paying a relatively high average rate. As revenue per ton-mile indicates, the cost related pattern is evident, namely the longer the haul, the lower the ton-mile revenue.

Motor Carrier Rates and Costs

More recently, motor carriers have played an increasingly significant role in the transportation of paper stock. This role has developed as a result of paperboard manufacturers' increased reliance upon motor carriers for the transportation of their finished products. Though the paper industry remains one of the railroads' best and most profitable customers, both private and contract motor carriage are increasingly the preferred mode for the movement of paperboard products over the short to medium distance spectrum.

Our analysis of motor carrier rates and costs is based on information furnished by shippers; this information is not available in the public record. While there is no ready method to test the data for their national representativeness, there is good reason to believe that it qualifies for the purposes of this study, because these data were furnished by shippers, generally large components of this industry, who handle a good cross-section of this traffic.

Common motor carriers of general commodities, as we mentioned at the beginning of this subchapter, have no interest in competing for the waste paper traffic. Their general rate structure is based on class 35 rates, which in some cases is 50 percent and more the level of contract carrier rates. Typical comparisons of the minimum differences are:

common:
Northlake, Il. to Kalamazoo, Mi., 153 miles, 41¢/cwt.

contract:
Chicago Il. to Wabash, In., 146 miles, 33¢/cwt = 80%
of common

common:
Fort Wayne, In. to Kalamazoo, Mi., 103 miles, 34¢/cwt.

contract:
Marietta, Oh. to Circleville, Oh., 115 miles, 25¢/cwt =
74% of common

Even at the relatively high rates charged by common carriers, as will be seen from Table 12, common carriers operated at a loss, on average, for the sample of 45 truckloads included in this analysis.

It follows that contract carriers at the lower rates charged operate also at a loss. While their overhead costs are lower, this is likely to be offset by their lower rates. But in a sample of some 29 moves examined up to 80 miles, contract carriers had average revenues of $1.20 per vehicle mile, almost 60 percent more than the common carriers in the 148 mile range. This difference was found to be due to a higher weight minimum, namely 20 tons, shippers paid for, though the average lading was only 16.3 tons. In the 240 mile range, contract carriers realized average revenues of only 57¢ per vehicle mile, as compared with 64¢ for a sample of common carrier moves of similar distance.

The single conclusion referred to before is that by virtue of the contract provisions between carriers and shippers, which virtually guarantee balanced traffic inbound and outbound, this mode of transport is serving its shippers most effectively, while keeping the rates for scrap paper relatively low.

Table 12

ANALYSIS OF WASTE PAPER SHIPMENTS MOVING VIA MOTOR COMMON CARRIERS, (SAMPLE OF ACTUAL TRAFFIC, FIRST QUARTER 1973)

Line	Item	Number or Amount
1	Truckloads	45
2	Tons	748
3	Revenue ($)	4,937
4	Average length of haul, miles	148
5	Short Line Vehicle Miles	6,677
6	Average Load Per Truckload, tons	16.6
7	Average Revenue Per Truckload ($)	110
8	Average Revenue	
	8.1 Per 100 Pounds, cents	33.0
	8.2 Per Vehicle Mile, cents	73.9
	8.3 Per Ton Mile, cents	4.3
9	Variable Cost, all moves, $	7,084
10	Contribution, all moves, $	(2,146)
11	Ratio of Revenue (%) to Variable Cost	69.7

Source: Lines 1, 2, 3, 4 furnished by shippers; Line 10 extracted from ICC Bureau of Accounts, Statement No. 2C1-70 for the year 1970. Consequently, variable cost data stated in Line 10 is understated to the extent it does not accurately reflect increases in operating expenses that have been incurred since 1970.

Further, it should be emphasized that rail movements of this commodity appear to be competitive at distances over 60 miles. However, most paper stock collection and processing points are not located on rail sidings. This inhibits the use of rail for shipments at or in excess of the average competitive cross-over point.

Findings

Summarization of the rate situation for these two commodities is difficult since there appear to be so many individual, peculiar rate situations. For example, a large volume of pulp and waste paper moves in intrastate commerce, and intrastate rates vary widely from state to state. The only thing common about intrastate rates is that they tend to be lower than the interstate level.

Nevertheless, some general observations can be made about the "average" rail traffic. Looking at all study moves, revenues produced by pulp amount to 187 percent of variable costs, while waste paper revenues amount to only 144 percent of variable costs.

Those figures mean little, however, unless the length of haul is considered. For short moves, up to about 200 miles, waste paper on average takes higher rates than pulp. On longer hauls, the situation is reversed, with pulp taking rates up to 35 percent higher than the paper.

For the short haul, these rate differences appear to be consistent with cost differences, since the contribution rate of up to 29 percent of revenue is about the same for pulp and waste paper on moves up to 200 miles. After that point, the contribution rate is considerably higher for the pulp moves, dictating a conclusion that the railroads are profiting relatively more from the pulp rates on the long hauls than they do in the movement of waste paper.

The railroad pricing strategy evidently reflects cost factors as well as responsiveness to competitive factors.

Motor carriers appear to be hauling paper stock at less than variable costs. They do so because it constitutes a backhaul which otherwise would produce no revenue at all, or an even greater out-of-pocket loss.

The industry is served well by contract carriage and private trucking for the short distance moves; this competition has also kept rail rate levels low for the short to medium distance hauls.

Glass Container Industry

Introduction

The glass container industry, SIC 3221, is composed of 95 plants in 25 states.[1] The plants are well distributed throughout the country, with concentrations in five states: California (14 plants), Pennsylvania (13), Illinois (nine), and New Jersey and Indiana (eight each). Figure 12 illustrates numbers of plants by states and value of shipments by Census regions.

The industry manufactures glass containers for commercial packing and bottling and for home canning. The value of the industry's shipments in 1967 was $1.35 billion, according to the Census of Manufactures for that year.

Manufacturers of glass containers consumed 73 per cent by volume of primary raw materials used by all glass producers in 1967. Makers of flat glass consumed about 15 per cent and producers of pressed and blown glass used about 12 per cent, the Census data show.

Relating glass container plant locations to railroad rate territories, more than half of the plants, a total of 50, are located in Official Territory. These plants accounted for about 70 percent of the value of all shipments in 1967. Mountain Pacific has 16 plants, the South has 14, the Southwest has 13, and Western Trunk Line has only two.

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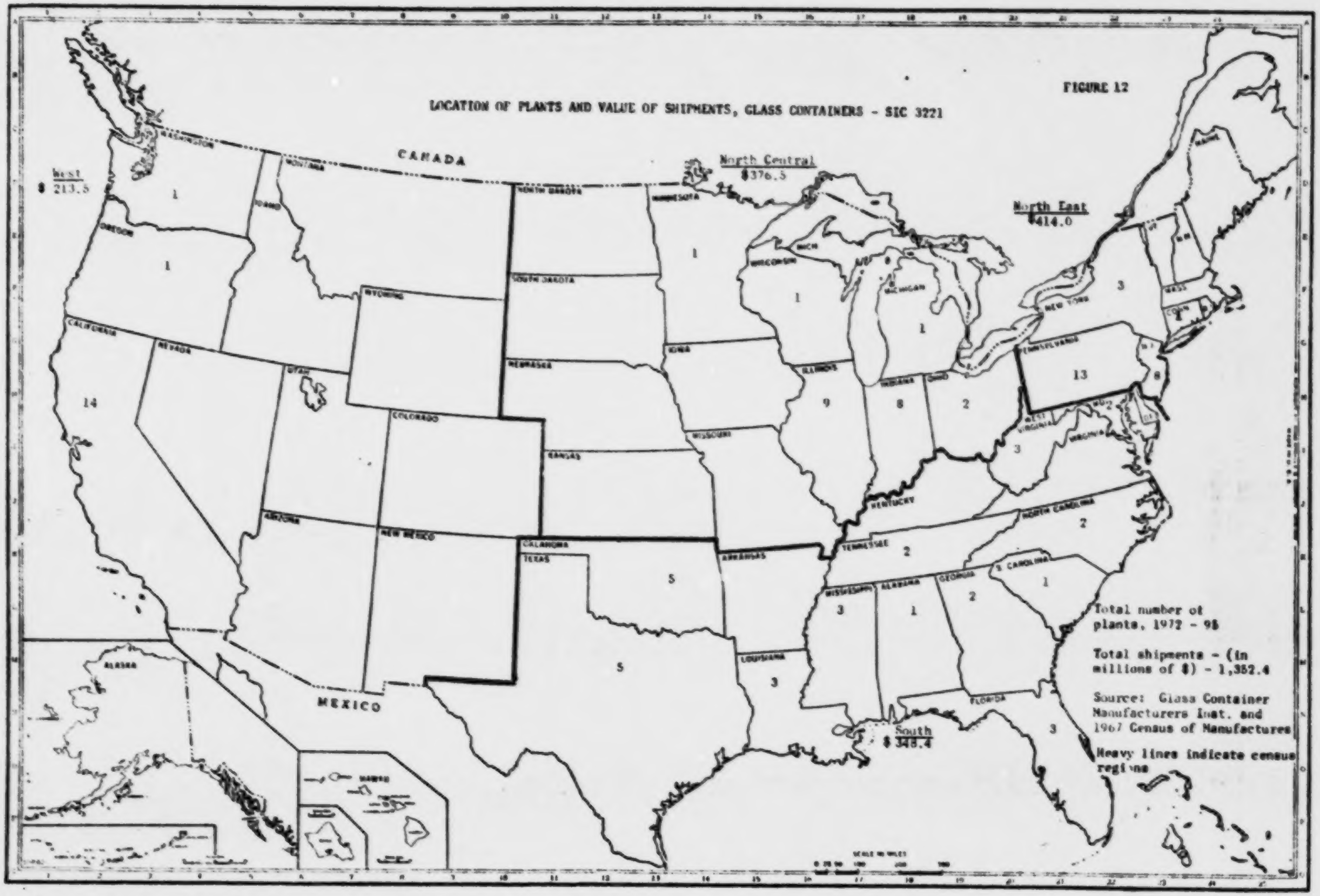
[1] Data supplied by Glass Container Manufacturers Institute, Inc., Washington, D.C.

FIGURE 12

LOCATION OF PLANTS AND VALUE OF SHIPMENTS, GLASS CONTAINERS - SIC 3221


CANADA
MEXICO
West
$ 213.5
North Central
$376.5
North East
$414.0
South
$ 348.4
WASHINGTON 1
OREGON 1
CALIFORNIA 14
MINNESOTA 1
WISCONSIN 1
MICHIGAN 1
ILLINOIS 9
INDIANA 8
OHIO 2
NEW YORK 3
PENNSYLVANIA 13
N.J. 8
MD. 2
WEST VIRGINIA 3
NORTH CAROLINA 2
TENNESSEE 2
S. CAROLINA 1
GEORGIA 2
ALABAMA 1
MISSISSIPPI 3
FLORIDA 3
LOUISIANA 3
OKLAHOMA 5
TEXAS 5
ALASKA
HAWAII

Total number of plants, 1972 - 98

Total shipments - (in millions of $) - 1,352.4

Source: Glass Container Manufacturers Inst. and 1967 Census of Manufactures

Heavy lines indicate census regions

The Commodities

Glass sand was chosen as the primary material for study and cullet (crushed or broken glass) was selected as the competing secondary material.

Approximately 10 million tons of sand were used by glass producers in 1968, a miniscule part of the 916 million tons that were "mined" for construction and industrial purposes.[1] Sand must be of high purity and specified size to be utilized in glass making. Deposits of glass sand are located at many diverse points throughout the country, but the major sources are in the Midwestern States.

Cullet can be used as a direct substitute for all the virgin materials in a glass batch; i.e., a ton of cullet can replace a ton of virgin materials in a batch. While cullet can be used as the exclusive input in making glass containers, it usually does not exceed 30 or 35 percent of the batch volume. It is mixed into batches to produce a faster melt, to reduce fuel consumption, and to improve the stiffness or viscosity of the batch.

Three categories of cullet are recognized by glass container manufacturers: (a) in-plant cullet, the remains of a defective batch, which is recycled into the glass furnaces; (b) commercial cullet, collected and shipped by cullet dealers; and (c) reclamation center cullet, that collected by civic and environmental groups and sold to container manufacturers on a delivered basis. In-house cullet obviously is the most desirable type to the manufacturers since they know its exact composition and purity.

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[1] _Mineral Facts and Problems_, Bureau of Mines Bulletin 650, 1970, p. 1193.

In order to utilize cullet effectively, a manufacturer must have a steady source; continuity in the production process and consistency in batch mixtures are essential.

There are but few cullet dealers in the United States. Seventeen were counted by the Glass Container Manufacturers Institute in 1971, and that number is thought to have dwindled with the opening of the numerous glass container collection centers in the last two years. Those centers have not solved the cullet supply problems of the manufacturers, for they get a highly variable mix of glass and an uneven volume from them. In addition, manufacturers cannot pay more than about $20 per ton of cullet delivered, a price that covers merely the collectors' cost of transportation in many cases. Faced with the extinction of cullet dealers, and the uncertainty of supply from reclamation centers, many container manufacturers are using little cullet today other than that generated in their plants.

Transport Characteristics

A heavy loading commodity, glass sand moves predominantly by rail, in loads weighing up to 100 tons. The average weight for all glass sand cars in the One Percent Waybill Sample was 68 tons, and for the moves selected for study it was 66.5 tons. Some sand shipments consist of several cars, up to five, but most are in single cars.

Glass sand moves in covered hoppers to prevent it from getting wet and clumping. Some of these hoppers are assigned exclusively to glass sand traffic, moving empty on the backhaul to sand pits. Shippers favor this arrangement for two reasons: they do not need to rely on railroads' general pool of cars for an adequate supply, and they avoid the necessity of washing the cars after each shipment. Railroads favor it because they need not be concerned about contaminating the sand with the residuals from the move of a different material in the same cars.

Some glass sand moves by truck, but at premium rates compared with rail rates. Trucking of sand is performed by contract carriers in dedicated service between sand pits and plants, by bulk common carriers, and, to a very limited extent, by private carriers.

Owens-Illinois Corporation, the largest manufacturer of glass containers, owns a fleet of van trailers which it uses to haul new containers outbound and sand or soda ash on return. The trailers are adapted with hatches in the top and a hopper in the bottom, so that the sand can be loaded and unloaded quickly. From 20 to 25 tons of sand can be hauled in such trailers.

Cullet also moves predominantly by rail, though in somewhat lighter loads. The average weight for cullet shipments (all single-car) in the 1969 One Percent Waybill Sample was 63 tons, and for the study moves it was 64 tons.

The average length of haul for all the moves was 472 miles, compared with an average of 359 miles for glass sand.

When cullet moves by rail, it usually is loaded in open-top hoppers. By truck it is loaded either from the top or placed in barrels in vans or trailers.

There is a limited amount of cullet moving free by truck, in the interest of environmental improvement and public relations. The motor carriers pick up the cullet (or uncrushed empty bottles) near outbound destination points when they have no other traffic on the backhaul.

Truckers also have published round-trip rates for glass container companies, providing a single charge for movements of containers outbound and cullet on return. The Interstate Motor Freight System, for example, maintains a rate of $366 (effective January 2, 1973) for truckload shipments of new glass from Indianapolis to Madison, Wis., and cullet on return to Indianapolis.

To encourage the movement of cullet and other materials moving for recycling purposes, the Interstate Commerce Commission issued new rules in 1971 to facilitate grants of new operating rights to carry such commodities. Under those rules, promulgated in Ex Parte MC-85, a trucker can apply for a special operating certificate to carry specified recyclable materials. The certificates are issued promptly and almost automatically, outside of the usual application process. These certificates can be (and often are) issued for nationwide authority.

There are no known movements of glass sand or cullet by barge.

5.4 Comparative Analysis

Thirty-eight rail movements were chosen for the transport analysis of the glass industry. Of that total, 21 were movements of glass sand and 17 were cullet. Since the matching process turned up only four unduplicated[1] pairs of moves of sand and cullet, most of the moves selected for study were supplemental. Two of the supplemental cullet moves were not in the waybill file, but were supplied by industry sources.

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[1] In several instances, one move of nine virgin or secondary commodities was used more than once in order to provide a "matched" move which would otherwise have lacked a counterpart move.

In determining the operating costs of these movements, Rail Form A cost factors for covered hoppers were used for glass sand and cost factors for open hoppers were used for cullet.

The rate search for the sand and cullet moves turned up an inordinate number of discrepancies between published rates and derived rates (revenues stated on waybills divided by weights). Despite assistance from industrial traffic managers in the glass container industries, many of these differences could not be reconciled. In the interest of employing a consistent method, the lower of the published rate or the derived rate was used. The time frame and other study constraints have precluded further investigation of this problem.

Common Moves

Few generalizations can be made about common moves of glass sand and cullet because there were only four pairs.

In each matched pair, the rate per ton was higher for the cullet than the sand. The ratio of cullet rates to sand rates ranged from 1.1 to 2.7.

The cost per ton was higher for cullet in all but one pair, in which a light load of sand (41 tons) was matched with a 60-ton load of cullet. That light load of sand produced an out-of-pocket loss with revenues of $87 and costs of $100. The cullet movement matched with it produced a contribution of $41.

With the exception of that pair, cullet consistently produced a higher absolute contribution per ton. When the cullet was lightly loaded, however, the sand produced a higher contribution per car.

One pair of common moves merits close examination because the movements were so similar. The sand move, 22 miles within New Jersey, weighed 74 tons, and the cullet move, 22 miles within Pennsylvania, weighed 73 tons. The cost per car and per ton were almost the same for each move, but the revenue for the cullet was 2.7 times the sand revenue. This resulted in revenues per car of $103 for the sand and $276 for the cullet. The contribution made by the sand car was only $1,or a little more than a cent per ton. The cullet car made a contribution of $175, an average of $2.40 per ton.

All Study Moves

The addition of supplemental moves to the glass sample broadened it considerably, from eight to 38, and provided a basis for some general conclusions about the transportation of the two commodities.

Table 13 and Figure 13 show the behavior of the rates and costs over distance. Average revenues per car and per ton rise with distance for both commodities.

In each mileage block, the rates per car and per ton of cullet exceed those of sand. The average rates for the 800-1000 mile block were $16.22 per ton for cullet and $9.31 for glass sand. In the first mileage block, the cullet rates are 1.88 times those of the sand, and in the succeeding blocks the ratios are: 1.40, 1.46, 1.12, and 1.73 respectively.

The same pattern is observed for ton-mile revenues. In the first mileage block, composed of moves up to 200 miles, the average ton-mile revenue is 7.3 cents for cullet and 4.5 cents for sand. The ton-mile revenues for cullet are greater in all but one mileage block, 601 to 800 miles.

Table 13

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

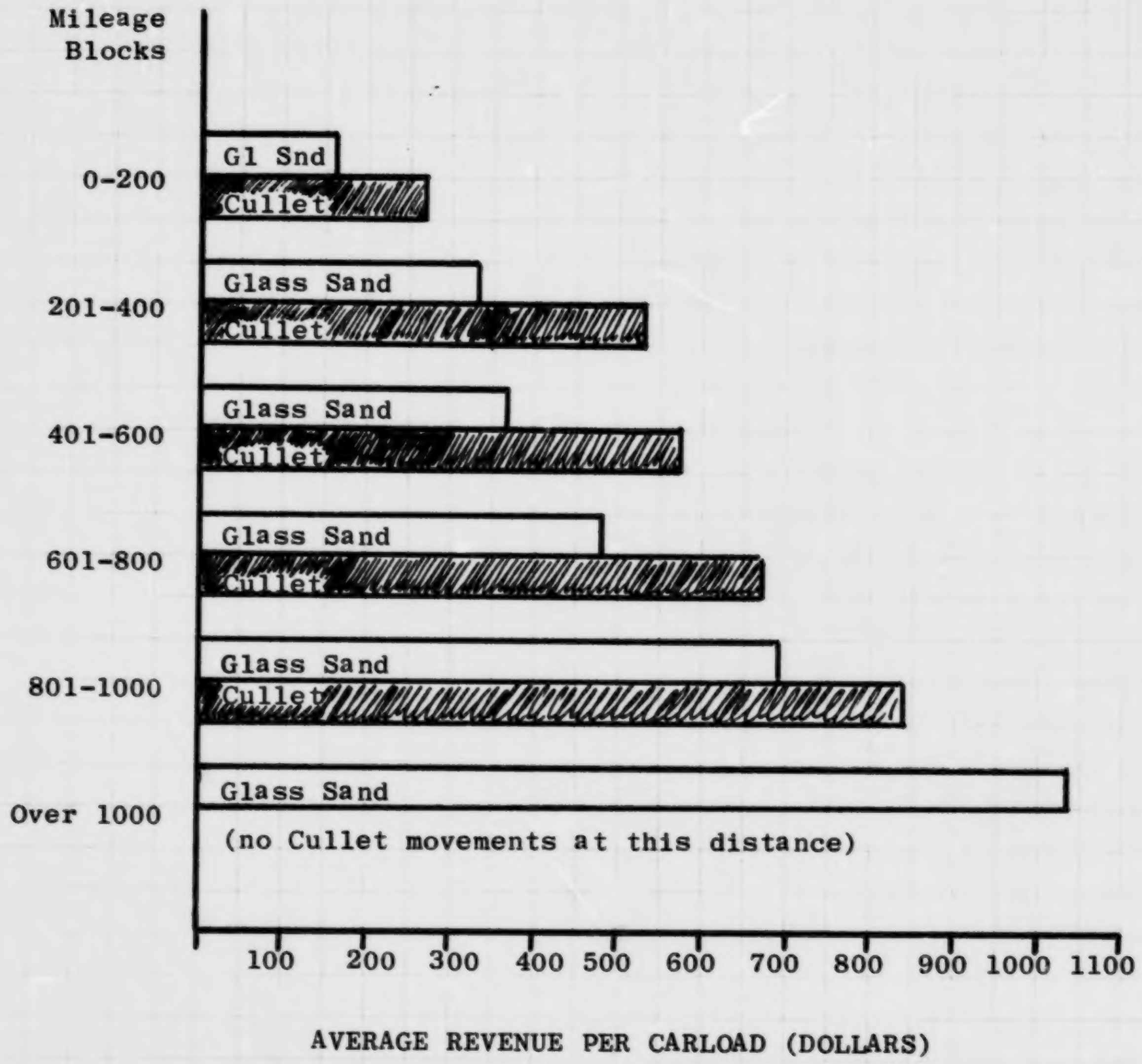
	Virgin Commodity: Glass Sand					Secondary Commodity: Cullet				
Mileage Blocks	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $
0-200	4	152	2.32	.045	.031	4	254	4.36	.073	.032
201-400	7	329	5.05	.017	.011	3	530	7.09	.020	.009
401-600	2	362	6.29	.012	.010	3	571	9.16	.020	.010
601-800	2	481	8.74	.017	.012	5	672	9.77	.015	.008
801-1,000	3	690	9.37	.010	.008	2	836	16.22	.019	.008
Over 1,000	3	1,037	13.41	.007	.006	-	-	-	-	-
All Blocks	21	465	7.00	.011	.008	17	550	8.57	.019	.009

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 13

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF GLASS SAND AND CULLET



Source: Computed from Master Tables, Appendix A

Total variable costs per mile of haul decrease gradually over distance for both commodities. The absolute amounts and the rates of decline per unit of haul are about the same for both sand and cullet.

Contribution amounts and percentages are shown in Table 14 and illustrated in Figure 14. These demonstrate that the railroads earn considerably more contribution for hauling cullet than sand, regardless of length of haul. The average contribution is $107 for a carload of glass sand and $282 for a carload of cullet.

Whereas the rate of contribution as a percent of revenue declined gradually with distance for the sand moves, it remains about the same for the cullet moves at all lengths of haul. In the first mileage block, the percentage contribution is 29.8 for sand and 56.6 for cullet, a ratio of 1.9. By the fifth mileage block, the percentage contribution for sand has declined to 21.7, but it has dipped only slightly for cullet, to 53.3, a ratio of 2.5.

This difference in rate treatment for the two commodities is further illustrated in Figures 15 and 16, depicting the "points of observation" for each of the study moves and the lines of best fit (see Appendix B). The lines show not only that contribution as a percentage of revenue is lower at all distances for glass sand, but also that the contribution rate drops faster over distance for sand than for cullet. While it is essential to temper this general conclusion by the facts that a relatively small number of observations were used to develop the slope of the contribution line and that the scatter is widely dispersed, the established trends appear to have validity.

Table 14

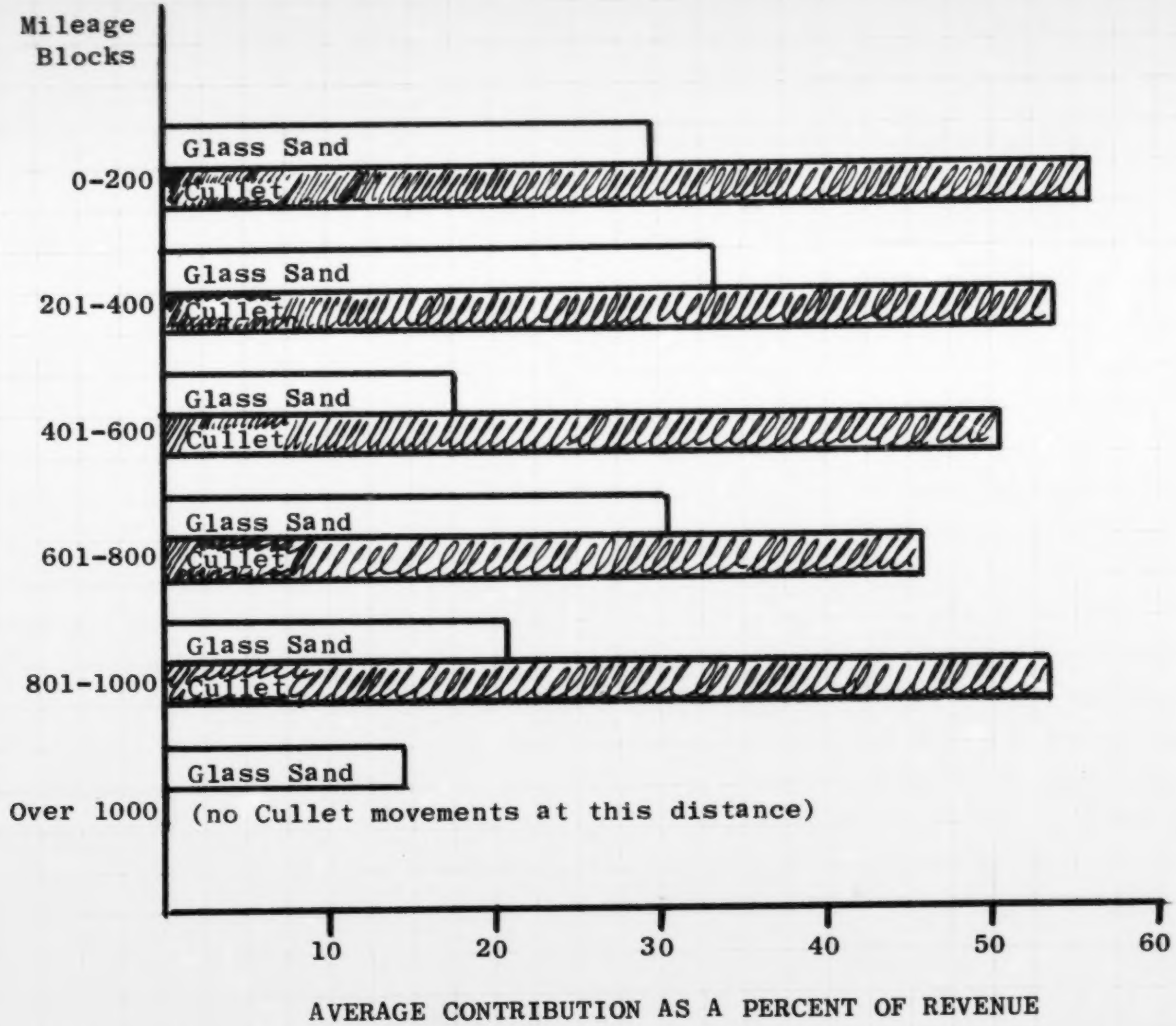
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

Mileage Blocks	Virgin Commodity: Glass Sand			Secondary Commodity: Cullet		
	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.
0-200	4	45.50	29.8	4	144.00	56.6
201-400	7	108.71	33.0	3	285.66	53.9
401-600	2	63.50	17.5	3	291.00	50.9
601-800	2	145.50	30.2	5	310.00	46.1
801-1,000	3	150.33	21.7	2	471.00	53.3
Over 1,000	3	145.33	14.0	-	-	-
All Blocks	21	107.05	23.0	17	282.23	51.3

Source: Computed from Master Tables, Appendix A.

Figure 14

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF GLASS SAND AND CULLET



Source: Computed from Master Tables, Appendix A

Figure 15

STCC: 1441320 Glass Sand

Contribution as a Percentage of Revenue

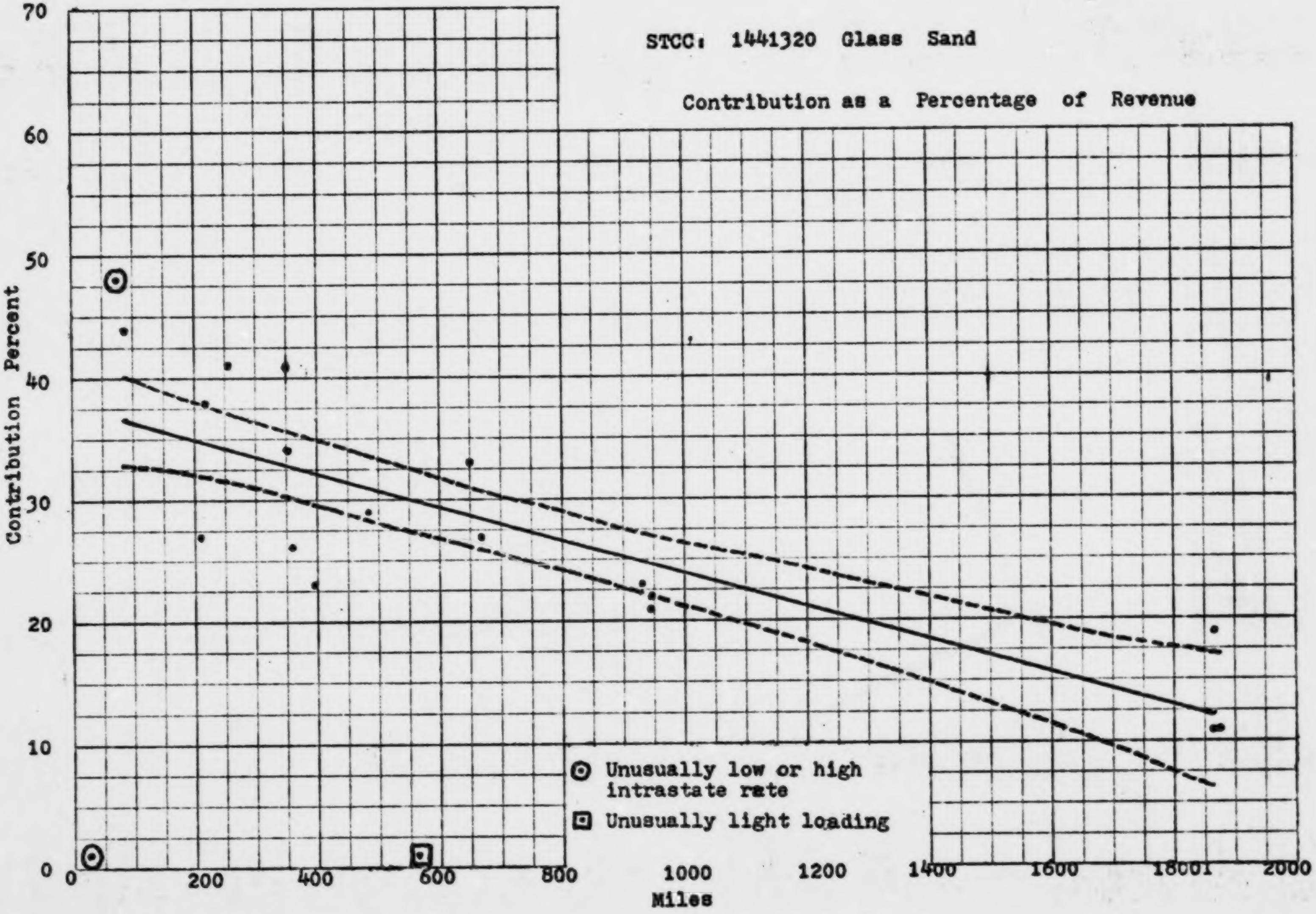
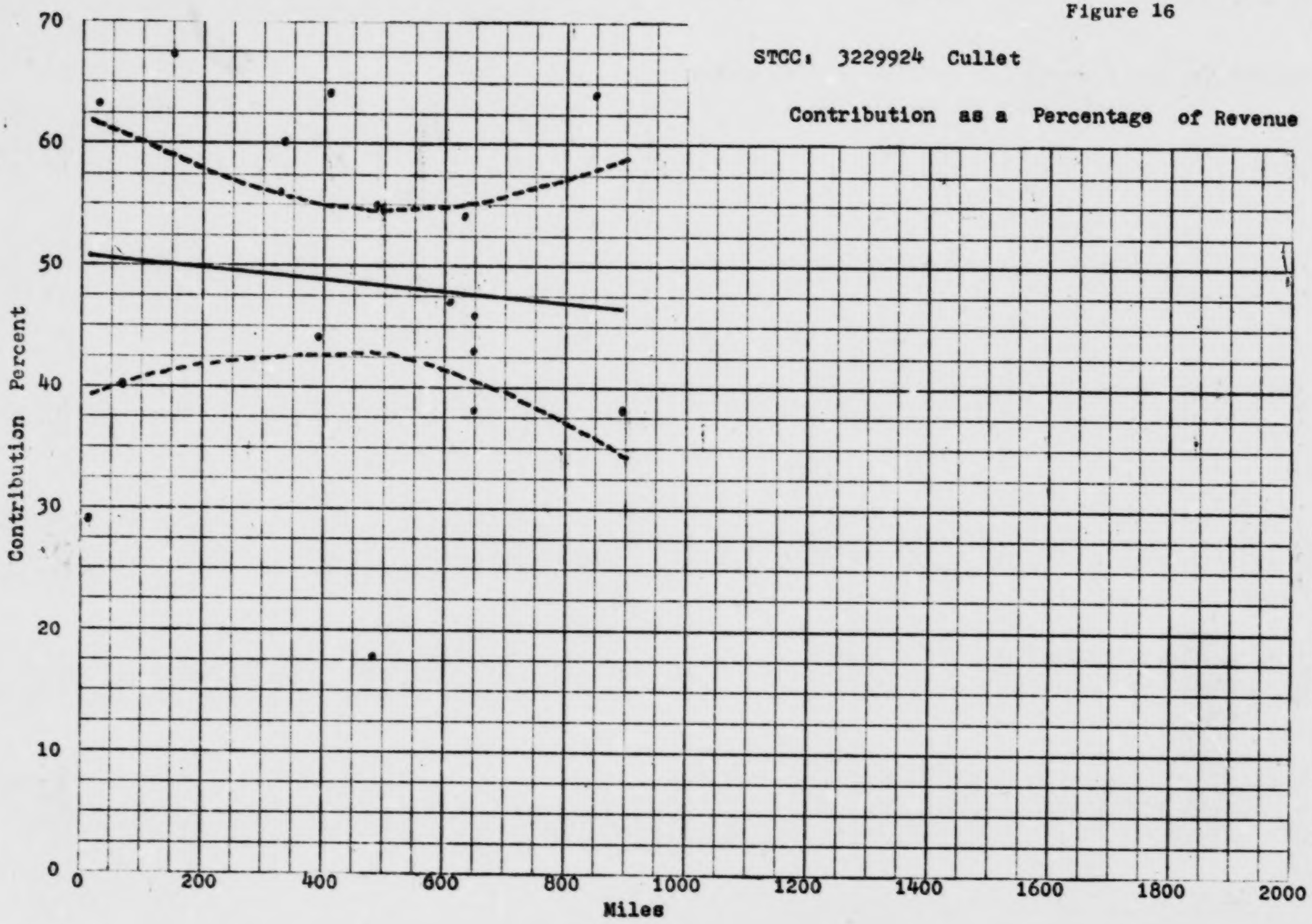


Figure 16

STCC: 3229924 Cullet

Contribution as a Percentage of Revenue



Analysis by Destination Territory

Data from the entire waybill data base were used to show rate differences by destination territory. This analysis is a look at rates from the vantage point of glass manufacturers, located at varying distances from material sources. A summary of the pertinent data follows:

TABLE 15

Rate Differences By Destination Territory, Glass Sand and Cullet

	GLASS SAND			CULLET		
Dest. Terr.	Avg. Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile	Avg. Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile
1	$4.83	290	1.66¢	$7.54	366	2.04¢
2	3.73	266	1.51¢	14.33	715	2.07¢
3	2.33	94	3.73¢	--	--	--
4	4.18	333	1.43¢	*	*	*
5	6.47	824	0.79¢	*	*	*

*Only one movement terminated in Territories 4 and 5 from which no conclusions can be drawn.

For glass moves a fairly clear-cut, though not entirely consistent pattern is evident. For the shortest average haul, in Territory 3-Western Trunk Line, the rate per ton is the lowest, and the average revenue per ton-mile is the highest; contrarily, in Territory 5-Mountain Pacific, the haul being the longest, the rate per ton is the highest, and per ton-mile revenue the lowest. The following ratios are interesting:

Ratios Territory 5 to 3:

length of haul	8.8
rate per ton	2.8
revenue per ton-mile	0.2

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For an average haul almost nine times the distance, the rate per ton is less than three times that for the shorter average haul and consequently the carriers' revenue per ton-mile of service for the long haul is only one-fifth that for the short haul. This is clearly an example of ratemaking which reflects both cost factors and other considerations. The cost factors referred to are the lesser total variable costs per car-mile or ton-mile for the long haul as compared with short ones.

The above data for the two cullet destination territories reveal much lesser consistency. The average rate per ton in Territory 2 is increased over the average rate for Territory 1 by about the same factor as the distance, both being about 90 percent. Consequently, the revenue per ton-mile is about the same for both territories, quite contrary to the observations for glass sand where a somewhat similar increase in the average haul (compare Territory 4 and 5, 824 miles versus 333 miles, an increase of 147 percent) resulted in a reduction in average ton-mile revenue from 1.43¢ to 0.79¢ or approximately 45 percent. In short, pricing for the cullet moves terminating in Territory 2 appears to have ignored the reduction in unit costs brought about by the substantially increased length of haul.

Findings

The cullet traffic appears to be considerably more profitable for the railroads than the glass sand traffic, notwithstanding the fact that the sand rates provide reasonable contribution rates.

All study moves considered, revenues earned on the glass sand movements were 129.8 percent of variable costs, whereas the revenues earned on the cullet moves were 204.5 percent of the associated variable costs; hence, the contribution to fixed costs for the cullet movements exceeded the variable costs of hauling that traffic.

Looking at rates over distance, the cullet rates are always higher than the sand rates, by magnitudes ranging from 1.12 to 1.88 times. Operating costs per car, on the other hand, are about the same for both commodities in the respective mileage blocks.

Not only is contribution as a percentage of revenue consistently higher for cullet than sand, but the contribution rate for sand declines more sharply over distance than for cullet. In fact, the contribution for cullet hovers around 50 percent of revenue at all mileage blocks and hardly declines at all with distance.

Secondary Aluminum Industry

Introduction

The secondary aluminum industry is a subgroup of SIC 3341, Secondary Nonferrous Metals. It comprises some 86 plants[1] widely distributed throughout the country, with a concentration in the East. The number of plants in each state is shown in Figure 17.

The primary product of the secondary smelters is alloyed ingot--bars of aluminum alloyed with other metals such as copper and magnesium to improve castability and strength. However, the industry also produces other nonferrous alloys, some of which contain large shares of recycled materials. Most of these alloys are cast into 15 or 30 pound ingots. Some secondary smelters are primarily in the die casting business and operate smelters only to supply their own metal requirements.

The value of secondary ingot shipments in 1967 was $302.9 million, according to the Census of Manufactures for that year. The Aluminum Recycling Institute, Washington, D.C. has estimated the value of shipments in 1972 at about $300 million, representing an output of about 750,000 net tons. (The Census and industry figures are not necessarily compatible, as different definitions may have been used.)

Secondary smelters consume about 70 percent of the available aluminum scrap in the United States. Non-integrated fabricators consume most of the other 30 percent.

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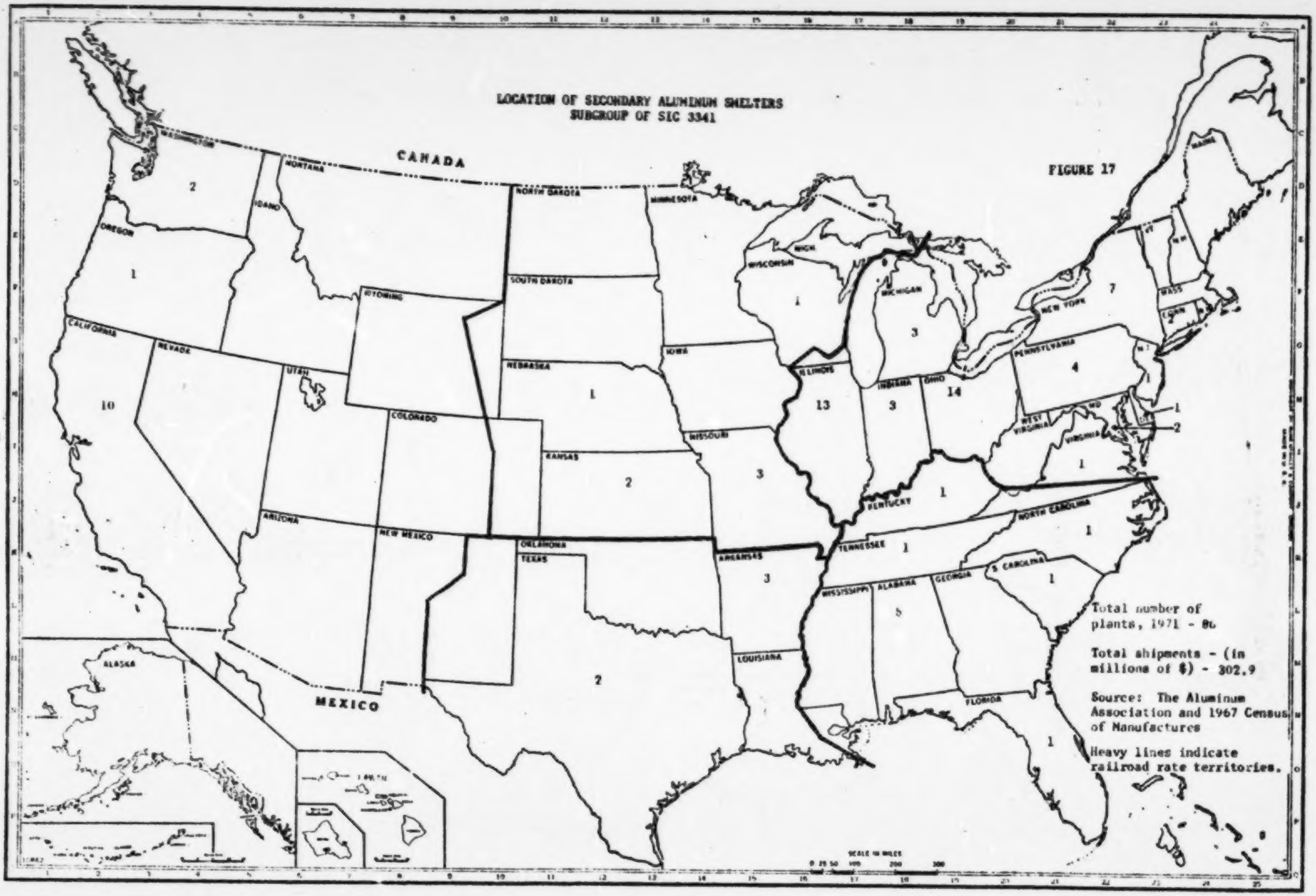
[1] Unofficial list compiled in 1971 by the Aluminum Association. It includes some die-cast plants that also operate smelters.

FIGURE 17


CANADA
MEXICO
WASHINGTON
2
OREGON
1
CALIFORNIA
10
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
1
KANSAS
2
OKLAHOMA
TEXAS
2
MINNESOTA
IOWA
MISSOURI
3
ARKANSAS
3
LOUISIANA
WISCONSIN
1
MICH
MICHIGAN
3
ILLINOIS
13
INDIANA
3
OHIO
14
KENTUCKY
1
TENNESSEE
1
MISSISSIPPI
ALABAMA
5
GEORGIA
FLORIDA
1
S CAROLINA
1
NORTH CAROLINA
1
VIRGINIA
1
WEST VIRGINIA
MD
1
2
PENNSYLVANIA
4
NEW YORK
7
N J
1
VT
N H
MAINE
MASS
CONN
2
ALASKA
SCALE IN MILES
0 25 50 100 200 300

LOCATION OF SECONDARY ALUMINUM SMELTERS
SUBGROUP OF SIC 3341

Total number of plants, 1971 - 86

Total shipments - (in millions of $) - 302.9

Source: The Aluminum Association and 1967 Census of Manufactures

Heavy lines indicate railroad rate territories.

The Commodities

Primary aluminum ingot, the virgin product made from alumina, and aluminum scrap were selected for study in the secondary aluminum industry.

Primary ingot is almost 100 percent pure aluminum. Most is shipped (or moved intraplant) to fabricators. Small amounts move to secondary smelters where it is used as a "sweetener" in the casting process. However, primary ingot makes up less than five percent of most secondary smelters' inputs.

Pure aluminum is being shipped increasingly in molten form, especially to large die casters, but this study is concerned only with ingot shipments.

Aluminum scrap can be classified as follows:

INDUSTRIAL SCRAP--A byproduct of the smelting or fabricating process. About two-thirds of industrial scrap is recycled within the industry and is dubbed as "runaround". The remainder is sold to secondary smelters and non-integrated fabricators.

One grade of industrial scrap is the residue left from the smelting process, known as skimmings and drosses. This type of industrial scrap, though, is a different commodity, being very low in aluminum content; it was excluded from this study.

OBSOLETE SCRAP--Fabricated aluminum products that have been discarded. Obsolete scrap makes up about 25 percent of the aluminum scrap consumed in the United States. It is collected by dealers who sort and grade it before forwarding it to consuming plants.

Secondary smelters often search for obsolete scrap that is already alloyed to meet a particular customer's specifications. Toward this end, scrap dealers and processors sort their scrap not only on the basis of grade but also metallic content.

Some processors also separate aluminum scrap attached to iron. The product of this process, known as "sweated pig", is sold to secondary smelters.

Transport Characteristics

Primary aluminum ingot moves mostly by rail, though some moves by other modes. Of all primary ingot transported in regulated service in 1969, about 89 percent moved by rail, nine percent by truck, and two percent by barge.

Motor carriers' share of the traffic is believed to be increasing. Ingot is attractive traffic to truckers because it is a compact, heavy loading commodity that is quickly loaded and unloaded.

It also loads compactly in rail cars, of course, and ladings of 80 tons per car are not unusual. Boxcars are usually used for the ingot traffic.

Aluminum scrap has varying transport characteristics, depending on type and grade. Dealers play an important part in collecting the scrap (both old and new industrial) and processing it into transportable forms.

Sheet, extruded material, and castings are usually baled into bundles for ease in handling and transporting. Borings and turnings of known analysis are stored in separate bins until sufficient quantities of each are available for shipment. Some borings and turnings of high purity and cleanliness are briquetted for shipment. Food containers and other thin packaging materials such as foil are pressed into bales for shipment.[1/]

Whereas most scrap moves to dealers' processing points by truck, it moves from these to consuming mills mostly by rail. Open hoppers are normally used for this commodity.

[1/] U.S. Bureau of Mines, Impact of Technology on the Commercial Secondary Aluminum Industry, Information Circular 8445, page 9. Washington, U.S. Government Printing Office, 1970.

The following table, based on all movements (except shipments of skimmings and drosses) of aluminum ingot and scrap in the 1969 One Percent Sample of Waybills, illustrates the transport characteristics of the competing commodities.

TABLE 16
Transport Characteristics
Primary Aluminum Ingot and Aluminum Scrap

	Primary Ingot	Scrap
Average load per car, tons	57	33
Average length of haul, miles	1,152	640
Average revenue per car, $	974	537

These data demonstrate that ingot loads almost twice as heavy as scrap and moves about twice as far, on average. The revenue per car reflects those differences.

The moves selected for study had mean ladings similar to those for the entire data base. The study movements of ingot have an average lading of 58.7 tons, and the scrap moves an average load of 31.5 tons. The average revenue per car of ingot was $1,004, compared with $443 for scrap.

Comparative Analysis

Six movements of ingot and three of scrap were selected for study based on the common moves criteria. One of the scrap moves was paired three times with ingot moves, and another scrap move was paired twice. Selection of supplemental moves expanded the sample to 27 ingot moves and 24 scrap moves.

Rail Form A cost factors for boxcars were used in computing costs of the ingot moves and cost factors for open hoppers were employed for the scrap moves.

Published rates were used for rate and revenue data shown in Appendix A and for all computations. However, in a few cases applicable rates were not readily available and the revenue amounts contained in the Waybill file were used instead.

Common Moves

The small number of common moves do not permit drawing any definitive conclusions. Nevertheless, some patterns are evident:

a. The ladings of the ingot moves were heavier than the scrap ladings.

b. The cost per ton was consistently higher for the scrap, and the cost per car was higher for scrap in all cases but one. The exception was a pair in which the ingot load was almost as light as the scrap load (42 tons of ingot and 40 tons of scrap).

c. The rate per ton was consistently higher for the scrap.

d. The ingot moves made a greater contribution per ton in all cases but one--the pair with the light ingot movement. However, contribution as a percent of revenue was higher for the ingot moves without exception.

All Study Moves

Judgments about the behavior of transportation rates and costs for the two commodities can be made with greater confidence on the basis of all study moves.

Table 17 and accompanying Figure 18 show the behavior of rates and costs for all moves over distance.

Table 17

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

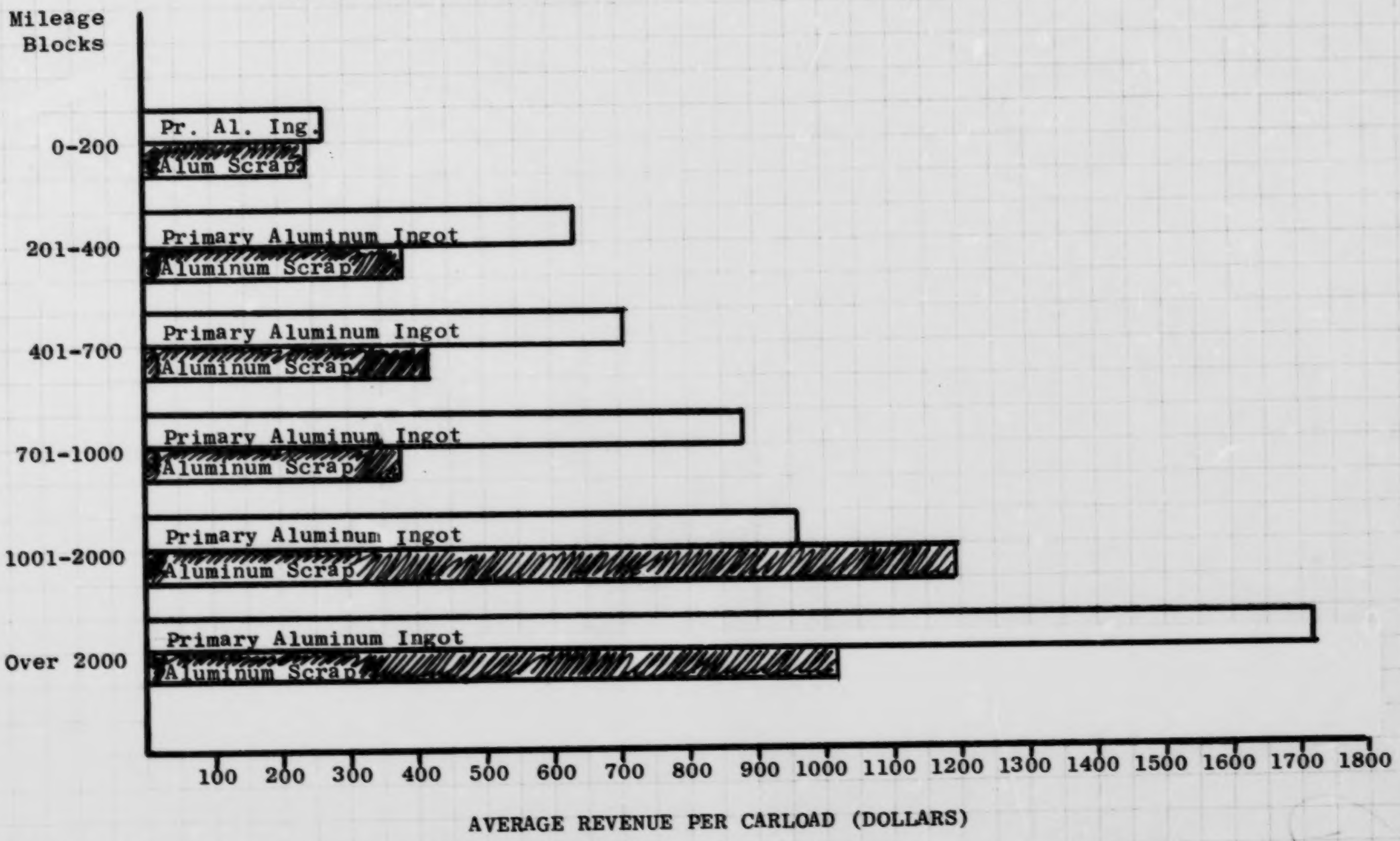
	Virgin Commodity: Primary Aluminum Ingot					Secondary Commodity: Aluminum Scrap				
Mileage Blocks	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton/Mile $	Average Var.Cost/ Ton Mile $	No. of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $
0-200	3	259	3.25	.023	.011	6	241	6.82	.065	.034
201-400	2	632	10.19	.032	.009	4	381	10.73	.041	.019
401-700	4	705	10.51	.018	.007	8	416	12.71	.026	.015
701-1000	4	886	18.74	.021	.008	3	372	24.80	.026	.026
1001-2000	7	956	18.43	.012	.006	1	1198	21.39	.019	.008
Over 2000	7	1716	29.89	.013	.006	2	1008	50.40	.020	.016
All blocks	27	1004	17.10	.014	.006	24	443	14.04	.027	.017

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue ÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 18

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF PRIMARY ALUMINUM INGOT AND ALUMINUM SCRAP



Source: Computed from Master Tables, Appendix A

For aluminum ingot, the revenues per car and per ton rise consistently with distance. The revenue per ton-mile figures decline gradually over distance, as would be expected, except that they rise from the first to the second mileage block. This phenomenon can be attributed to the low ton-mile revenues in the first mileage block (up to 200 miles). Two of the three shipments in that first distance block weighed more than 90 tons, accounting for the low unit revenues.

The average variable cost per ton-mile for the ingot moves is 1.1 cent for the first mileage block and a lesser amount in each succeeding block. The average cost per ton-mile for the longest moves is 0.6 cents.

The rate pattern over distance is more erratic for aluminum scrap. The expected regular progression of rates is exceeded in mileage block 4 (700 to 1,000 miles) where the average rate per ton is high. Yet revenue per car is lower than for moves in the 201 to 400 mile block. This peculiarity, high rate per ton/low revenue per car is explained by the fact that two of the three study moves in this distance block have ladings of only 11 tons. Variable costs per ton-mile are shown to be equal to revenue per ton-mile. The single move in the next mileage block (1,001 to 2,000 miles) demonstrates the effect of heavy lading. This car was loaded with 56 tons which produced revenue of almost $1,200, more than 1.3 times the variable costs.

Comparing the rates for ingot with those for scrap more generally, it is shown that scrap rates are higher in all mileage blocks, but in a few the difference is not significant.

There is a wide divergence in rate levels only in mileage block 1, where the low ingot rate of $3.25 per ton is attributable to the 90-ton shipments, and in the longest mileage block (over 2,000 miles), where the resulting very high scrap revenue of $50.40 per ton is explained by light ladings of only 20 tons for each of the two movements. The average revenue per car for these two movements is lower than for the shorter move in the preceding mileage block. Put differently, the high rate per ton merely resulted in about the same ton-mile revenue as a rate which is only 42 percent of that high rate.

Both commodities produce a sizeable contribution, as illustrated in Table 18 and Figure 19. Contribution per car of ingot ranges from $137 in the first mileage block to $924 in the last, and contribution as a percent of revenue is less than 50 percent in only one mileage block. Contribution per car figures are not so large for the scrap moves, but contribution as a percent of revenue is above 40 percent in four of the six mileage blocks. In one mileage block, where two of the three moves had ladings of only 11 tons, the scrap moves produce a very low average contribution, $5 per car, or 1.3 percent of revenue.

The ingot movements produce nearly as high contribution rates at the longest hauls as they do for shorter movements. Regression technique to obtain a line of best fit, as shown in Figure 20, shows that over the entire distance spectrum the average decline in rate of contribution as a percent of revenue is only one-half percent per 100 miles of incremental distance. For the aluminum scrap movements contribution as a percent of revenue, Figure 21

Table 18

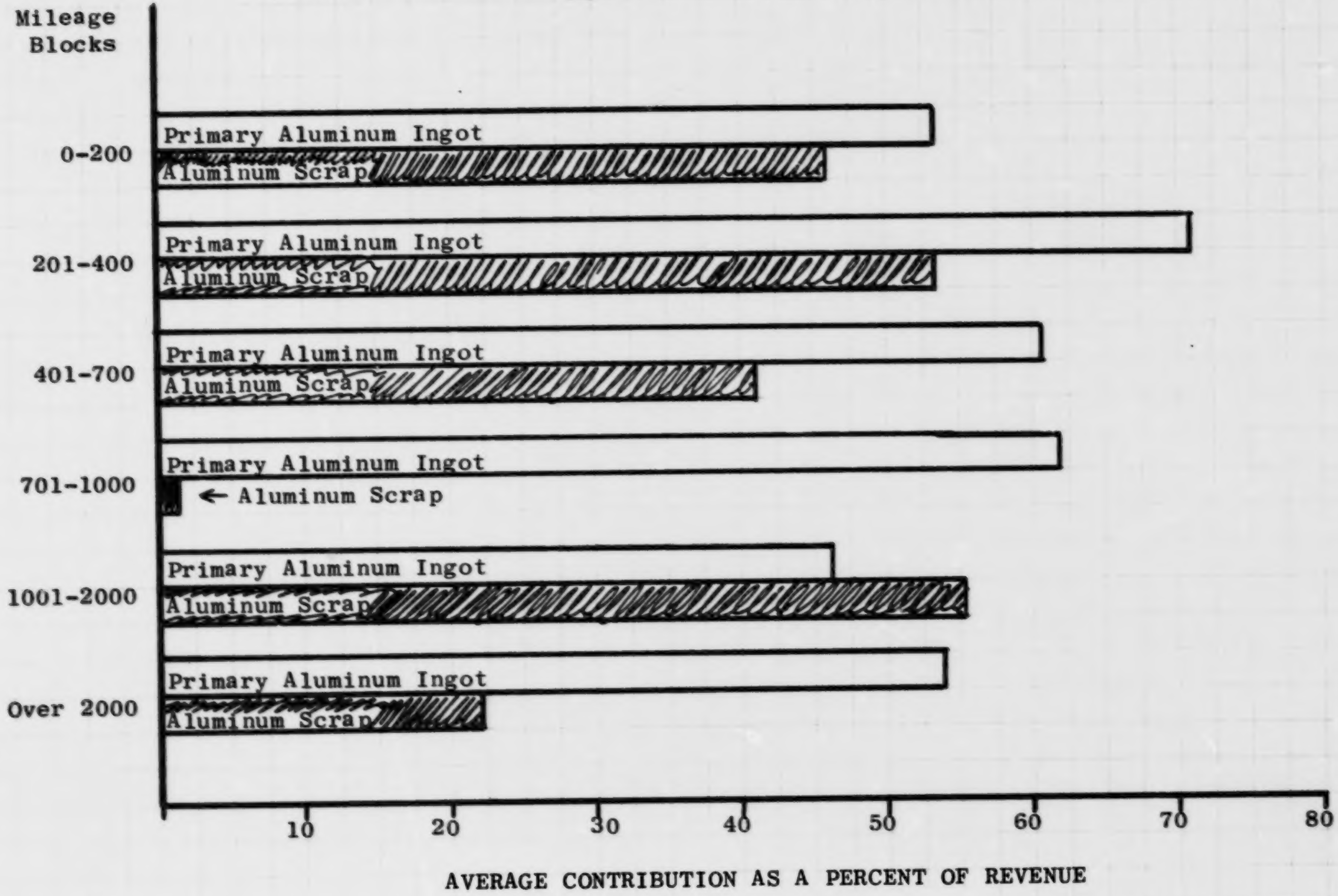
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

	Virgin Commodity: Primary Aluminum Ingot			Secondary Commodity: Aluminum Scrap		
Mileage Blocks	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.
0-200	3	137.00	52.9	6	113.50	47.0
201-400	2	454.50	71.9	4	201.75	52.9
401-700	4	428.75	60.8	8	172.25	41.3
701-1000	4	547.25	61.8	3	5.00	1.3
1001-2000	7	448.29	46.8	1	666.00	55.5
Over 2000	7	924.57	53.8	2	222.00	22.0
All Blocks	27	549.41	54.7	24	166.29	37.5

Source: Computed from Master Tables, Appendix A.

Figure 19

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF PRIMARY ALUMINUM INGOT AND ALUMINUM SCRAP



Source: Computed from Master Tables, Appendix A

Figure 20

STCC: 33341 Primary Aluminum Inget

Contribution as a Percentage of Revenue

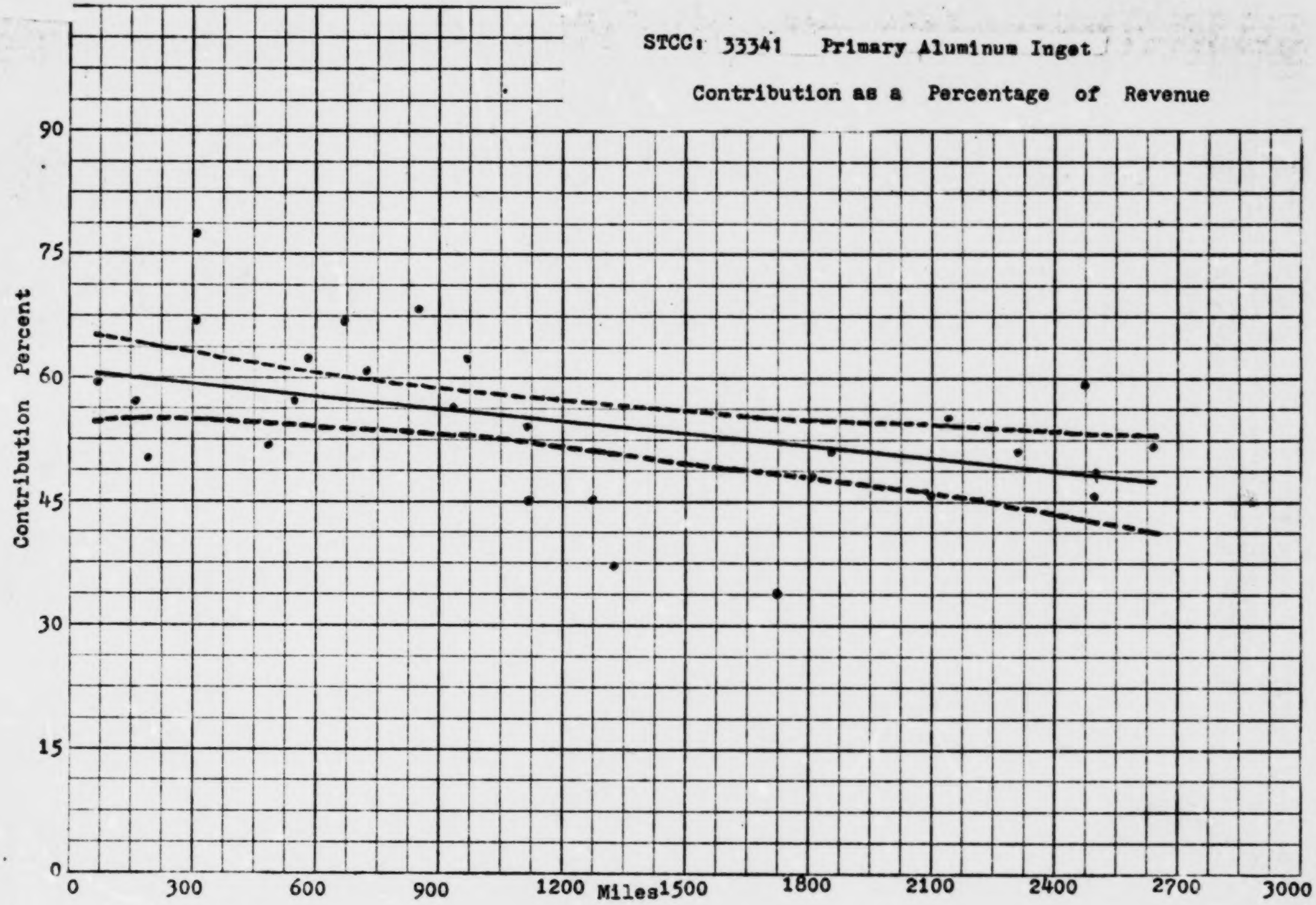
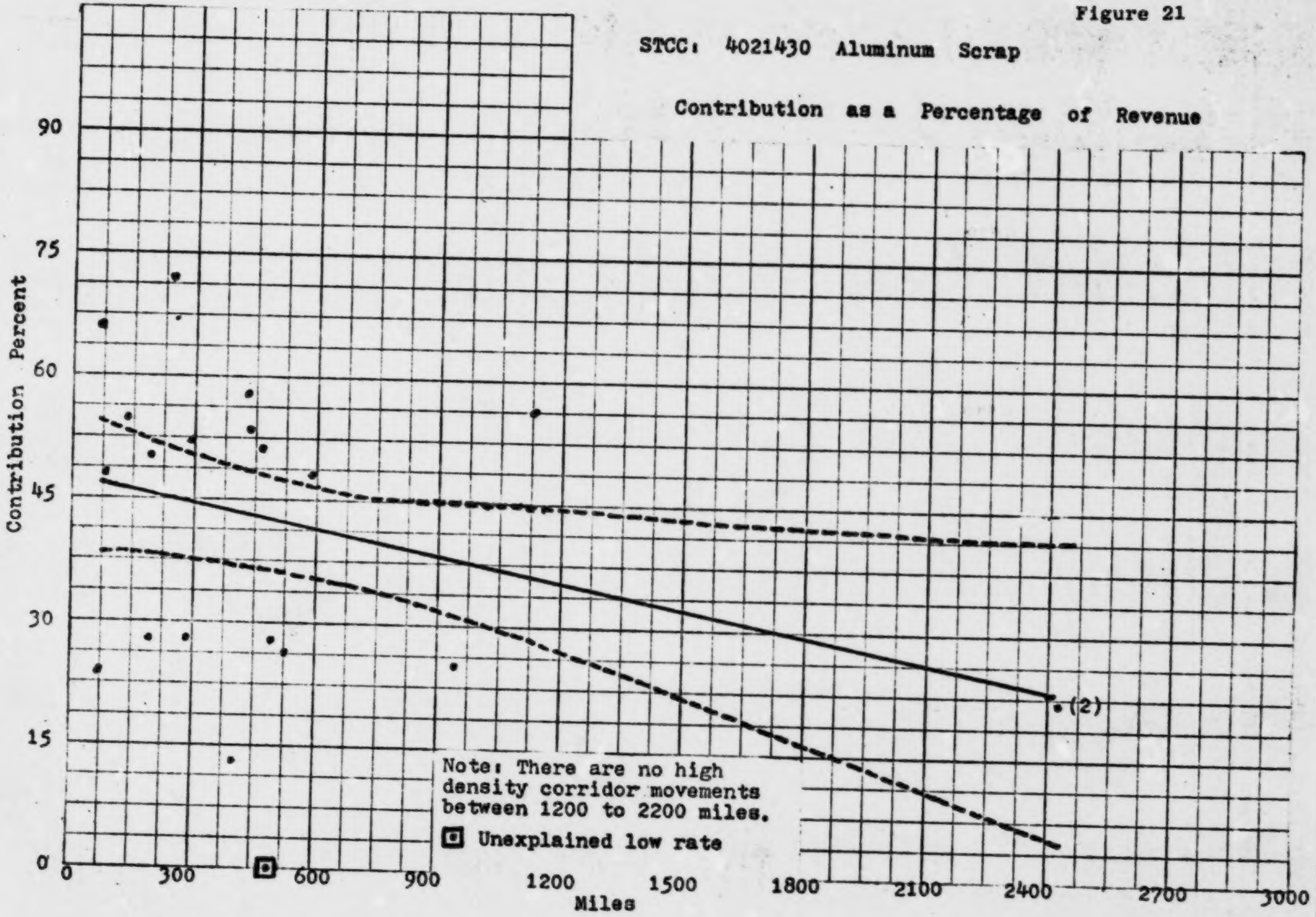


Figure 21

STCC: 4021430 Aluminum Scrap

Contribution as a Percentage of Revenue



shows a lower average level and a greater rate of decline over distance. The line of best fit shows an average contribution rate of about 47 percent for the shortest moves and about 22 percent for the longest, averaging in a decline of about one percent per 100 miles of incremental distance, or approximately twice the rate of decline for the primary product. However, as can be seen from the upper confidence band in Figure 21, the "range" indicated produces an almost flat line, and if it were not for the observations in the 2,400 mile distance block, indeed no decline of any significance would be notable in the scrap contribution rate.

Analysis By Destination Territory

This comparative analysis shows freight costs in different destination territories. This analysis employs the data contained in the Waybill file; it is summarized in the table following.

TABLE 19

Rate Differences By Destination Territory
Primary Aluminum Ingot and Aluminum Scrap

	INGOT			SCRAP		
Dest. Terr.	Avg. Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile	Avg. Rev. Per Ton	Avg. Haul (mi.)	Avg. Rev. Per Ton-Mile
1	$19.62	1,260	1.51¢	$15.61	601	2.52¢
2	14.30	972	1.52¢	20.04	888	2.22¢
3	19.30	1,515	1.28¢	18.22	744	2.13¢
4	15.85	1,140	1.47¢	14.18	536	2.67¢
5	11.14	760	1.59¢	13.07	538	2.38¢

Both ingot and scrap are shown to follow distance-based patterns, though there are some inequities as between territories.

Territory 3 ingot receivers are located the farthest from their supply sources; they pay the lowest ton-mile rate and a lower rate per ton than consignees in Territory 1, though the latter's average haul is some 250 miles shorter. Conversely, Territory 5 receivers are closest to shipping points and pay the highest rates per ton-mile, and the lowest average rate per ton.

Scrap receivers in Territory 2 are located farthest from shipping points and accordingly are paying the highest rates per ton, but they are not getting the lowest rates per ton-mile. Territory 3 receivers, though their average haul is about 20 percent shorter than those in Territory 2, are paying the lowest ton-mile rates. Consignees in Territories 4 and 5 incur almost exactly the same average distance haul, but the Territory 4 railroad customers are paying $1.11 more per ton and .29¢ more per ton-mile than those in Territory 5. Overall, the differences are not great. The ton-mile rate in Territory 4 for the shortest average haul is 25 percent higher than the lowest ton-mile rate, in Territory 3, to which an average haul 39 percent longer than in the shorter haul territory applies.

Findings

Despite different loading and length of haul characteristics, the rates for the two commodities are at similar levels. Table 17 shows, for example, that for moves of about 400 miles, the rates per ton are about $10 and $11 for ingot and scrap respectively. Where a considerable difference in the rate per ton was noted, it was attributable to a light lading.

The transport costs being higher for scrap, and the rates being roughly the same, the ingot movements consistently make a higher contribution. For all ingot movements in the study, the average contribution per car was $549, or about 55 percent of revenue. This compares with an average contribution of $166 per car of scrap, which was approximately 38 percent of revenue.

Contribution rates decline as distances increase for both commodities; the decrease over distance in the contribution made by the scrap traffic is about twice that for ingots. The latter averages over 50 percent for all study movements, but some observations showed contribution rates of 33 percent and 36 percent.

Reclaimed Rubber Industry

Introduction

Rubber reclaimers comprise a small and declining industry. SIC 3031, as the Commerce Department classifies it, had 24 establishments in 1967, according to the Census of Manufactures for that year. A Public Health Service report in 1969 listed 20 plants[1], and the Rubber Manufacturers Association's 1972 Red Book listed only nine U.S. plants. Most of the reclaimers are located in Official Territory, as Figure 22 shows.

Reclaimers buy used tires, other obsolete rubber products, and industrial scrap, such as buffings, and convert them into a substance that can readily be used by rubber fabricators. The reclaimers principally supply tire manufacturers, but they also sell to makers of floor mats, tubing, hoses, and other products. Reclaimed rubber is often produced to custom specifications.

The value of shipments from reclaiming plants was $43.8 million in 1967, according to the Census data.

Reclaimed rubber has been steadily declining as an input to the rubber fabricating industry. The Rubber Manufacturers Association reports[2] that in 1940 the reclaimed rubber consumed amounted to 29.2 percent of the new rubber (natural and synthetic) consumed. By 1950, the percentage had dropped to 24.1 percent; in 1960 it was 17.7 percent, while in 1970 it was only 8.1 percent.

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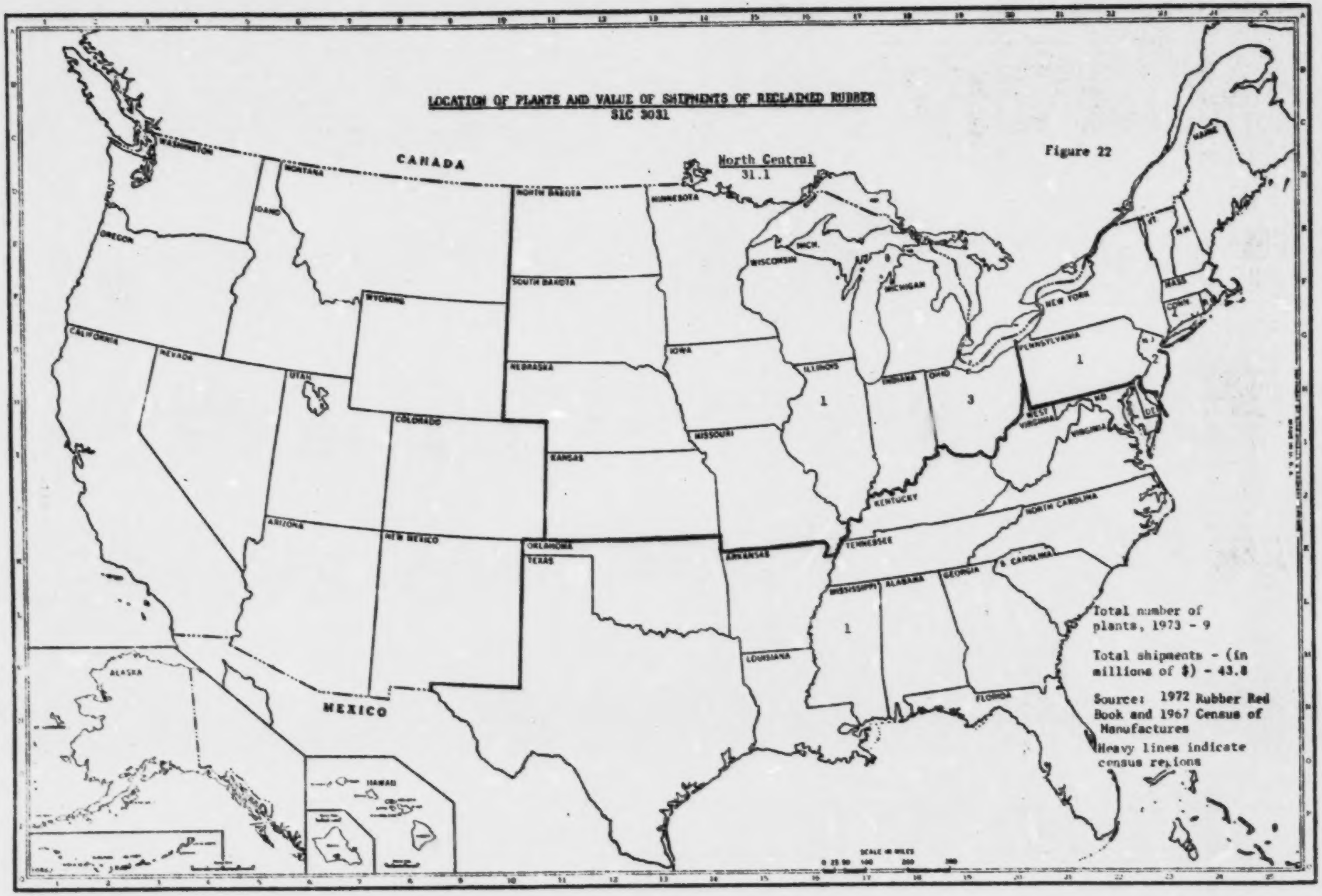
[1] Pettigrew, R.J., and F. Roninger, Rubber Reuse and Solid Waste Management (Public Health Service Publication No. 2124) Washington, U.S. Government Printing Office.

[2] Rubber Manufacturers Association, Rubber Industry Facts, New York, 1972.

Figure 22

LOCATION OF PLANTS AND VALUE OF SHIPMENTS OF RECLAIMED RUBBER
SIC 3031


CANADA
MEXICO
North Central
31.1
WASHINGTON
OREGON
CALIFORNIA
IDAHO
NEVADA
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICH.
MICHIGAN
ILLINOIS
1
INDIANA
OHIO
3
KENTUCKY
TENNESSEE
MISSISSIPPI
1
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
MD
DEL
PENNSYLVANIA
1
N.J.
2
NEW YORK
VT
N.H.
MASS
CONN
1
R.I.
MAINE
ALASKA
HAWAII
SCALE IN MILES

Total number of plants, 1973 - 9

Total shipments - (in millions of $) - 43.8

Source: 1972 Rubber Red Book and 1967 Census of Manufactures

Heavy lines indicate census regions

The Commodities

Four commodities were chosen for study in the rubber industry analysis: natural, synthetic and scrap rubber moving to reclaiming plants, and reclaimed rubber moving out. The transportation characteristics are very similar for synthetic and non-latex natural rubber; consequently, for most of the analyses herein the two commodities were treated as one.

Two transportation models were devised for this industry. In the first, new rubber (natural and synthetic) was compared with scrap, and in the other, new and reclaimed rubber were compared.

Natural rubber moves in two forms--liquid latex and solid. Movements of only the solid form were used for this study. Natural rubber is produced in the Far East and Africa and imported through the East, West and Gulf coasts.

Synthetic rubber is shipped only in solid form. Virtually all of the synthetic rubber consumed in the country is produced domestically. About 78 percent of the new rubber consumed in the United States in 1971 was synthetic, according to the RMA.[1] Consumption consisted of 2.1 million long tons of synthetic and 577,800 long tons of natural rubber.

Reclaimed rubber is a composite slab material which has varying characteristics, depending on the original rubber product that goes into it. It contains not only rubber hydrocarbon, but other ingredients such as carbon black and zinc oxide which otherwise would have to be introduced separately into a fabricator's batch.

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[1] Rubber Industry Facts, supra.

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Obsolete rubber scrap is generally worthless as a marketable commodity. This is exemplified by the fact that auto service stations pay to get rid of old tires. Reclaimers, however, at times pay amounts ranging up to $15 per ton for old tires delivered to them.

Industrial scrap has a considerably higher value than old tires. Reclaimers pay $25 to $35 per ton for retread buffings, $120 to $160 per ton for natural rubber inner tubes, and $100 to $120 per ton for butyl rubber inner tubes.[1/]

Scrap consumed by reclaimers in 1968 included discarded tires, tire parts (from tire splitters and others), retread buffings, inner tubes, and similar obsolete products (43.7 percent of inputs); rubber manufacturing scrap (7.5 percent); and other industrial rubber scrap (48.8 percent). Rubber reclaimers used about 71,000 tons of old tires that year.[2/]

Transport Characteristics

Natural, synthetic and reclaimed rubber move in slabs and bales, with bales averaging 70 pounds each.

I.C.C. statistics for regulated intercity traffic in 1969 indicate that railroads hauled about 80 percent of the natural rubber, 75 percent of the synthetic rubber, and half of the reclaimed rubber (see Appendix Table D). Those figures do not take into account the quantities moved by private carriers or local exempt truckers.

1/ Darnay, A., and W.E. Franklin, Salvage Markets for Materials in Solid Wastes, p. 82. Midwest Research Institute, Kansas City, Mo., for the U.S. Environmental Protection Agency, 1972.

2/ Salvage Markets for Materials in Solid Wastes, p. 81.

Scrap tires, not having an established market demand like other commodities, do not move in any regular transport pattern. If they move at all, they move the cheapest way possible, especially since the "seller" must absorb the freight and seldom collects more for the shipment than the freight cost. In order to rid their garages of old tires, dealers and service stations will use their own trucks to take tires to scrap dealers, retreaders or reclaimers.

Industrial scrap, being of higher value, usually moves to reclaimers by motor common carrier or railroad. Scrap dealers buy common carrier transportation and also use their own trucks to ship scrap to reclaimers.

The following table summarizes data from the One Percent Waybill Sample on the four commodities selected for study in the rubber industry.

TABLE 20

Transport Characteristics of Study Commodities in the Rubber Industry

	Natural Rubber	Synth. Rubber	Reclaim. Rubber	Scrap Rubber
Number of Waybills[1]	67	331	20	11
Average load per car, tons	34	57	46	22
Average length of haul, miles	664	817	809	482
Average revenue per car, $	491	774	820	301

The average ladings of the moves chosen for study were 34 tons for natural rubber, 52 tons for synthetic, 51 tons for reclaimed and 29 tons for scrap.

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[1] These data are included to show the deficiency in the number of waybills for reclaimed and scrap rubber--a deficiency that somewhat restricted the analysis of these commodities.

Comparative Analysis

As noted previously, two analyses were made for this industry: a comparison of new and scrap rubber movements, and a comparison of new and reclaimed rubber movements. A total of 29 waybills of new rubber (20 of synthetic and nine of natural), 10 waybills of reclaimed, and seven waybills of scrap were chosen for study. The scrap movements incorporated in this study include three heavy corridor moves supplied by industry sources.

Rail Form A cost factors for boxcars were used in determining costs of the movements of all four commodities.

Due to numerous differences between derived rates and those found in the search of ~~the published~~ tariffs, there was some doubt as to whether the right published rates had been found. Assuming that shippers would pay only the lesser of the published rates or the Waybills revenues, the lower of the two rates used in this study. Very scant industry participation, an association seemingly unable to provide any of the much needed information, and the dearth of publicly available data account for the uncertainties and lack of definitiveness in our study of this industry.

Common Moves

In the selection of common moves, natural and synthetic rubber were treated as a single commodity. Hence, matched movements of new and scrap rubber may represent a scrap waybill matched with a haul of natural or synthetic rubber. The same methodology was used in matching new and reclaimed rubber movements. However, waybills matched with the scrap are different from those matched with the reclaimed, due to the different origins and destinations for the two secondary commodities.

New *vs*. Scrap Rubber

Five pairs of movements resulted from the matching of new and scrap rubber waybills. One scrap movement, from Medford, N.J. to Akron, Ohio, had to be used four times to match movements of new rubber.

All cars in this analysis were lightly loaded, the heaviest being 30 tons. The new rubber weighed less than the scrap in four of the five pairs.

The cost per ton and rate per ton were higher for the new rubber in four of the five pairs. The exception was a very light (15-ton) movement of scrap paired with a 29-ton movement of new rubber. Contribution comparisons for the five pairs of moves produced inconclusive results. Contribution per car and per ton were higher for new rubber in two cases. However, in only one pair did new rubber have both a higher revenue per car and revenue per ton.

New *vs*. Reclaimed Rubber

Eleven movements of new rubber were matched with five movements of reclaimed to produce 11 pairs of common moves. Few conclusive findings resulted from this analysis.

As in the previous comparison, the new rubber moves were exceptionally light, with the new rubber shipments weighing less than the reclaimed in seven of the 11 pairs.

Costs per car were higher for the reclaimed in seven of the pairs, a consequence of the weight differences. However, the cost per ton was higher for the reclaimed in only four cases.

Rates were very similar in most of the pairs. Scrap rates were higher in seven cases and new rubber in four.

Amounts of contribution per car and per ton were higher for the scrap in all but two cases. Over the movement range of 185 miles to 1,027 miles, the range of the contribution per car for the scrap moves was $391 to $578, while it was $91 to $595 for the new rubber. Contribution as a percent of revenue was greater for the scrap in the same nine pairs.

All Study Moves

The following analyses are based on all study moves, including supplemental ones chosen from the One Percent Waybill Sample and from industry data.

New *vs*. Scrap Rubber

When the natural and synthetic rubber movements are arrayed by mileage blocks (Table 21 and Figure 23), they show a regular progression: average revenues per car and per ton increase with distance, while average revenue per ton-mile and average variable cost per ton-mile decrease with distance.

There are no scrap rubber moves in the two longest mileage blocks, but the scrap moves in the three distance blocks for which data were available behave in the normal manner. The two moves in the 601 to 1,000 mileage block have rates that appear somewhat low in relation to the other scrap moves. This is probably because they are 40-ton moves, considerably heavier than the other scrap shipments.

The average revenues per car are markedly lower for the scrap than the new rubber. In the first mileage block, they are 46 percent lower; in the second, 31 percent lower, and in the third, 34 percent lower. Revenues per ton are about the same.

Table 21

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

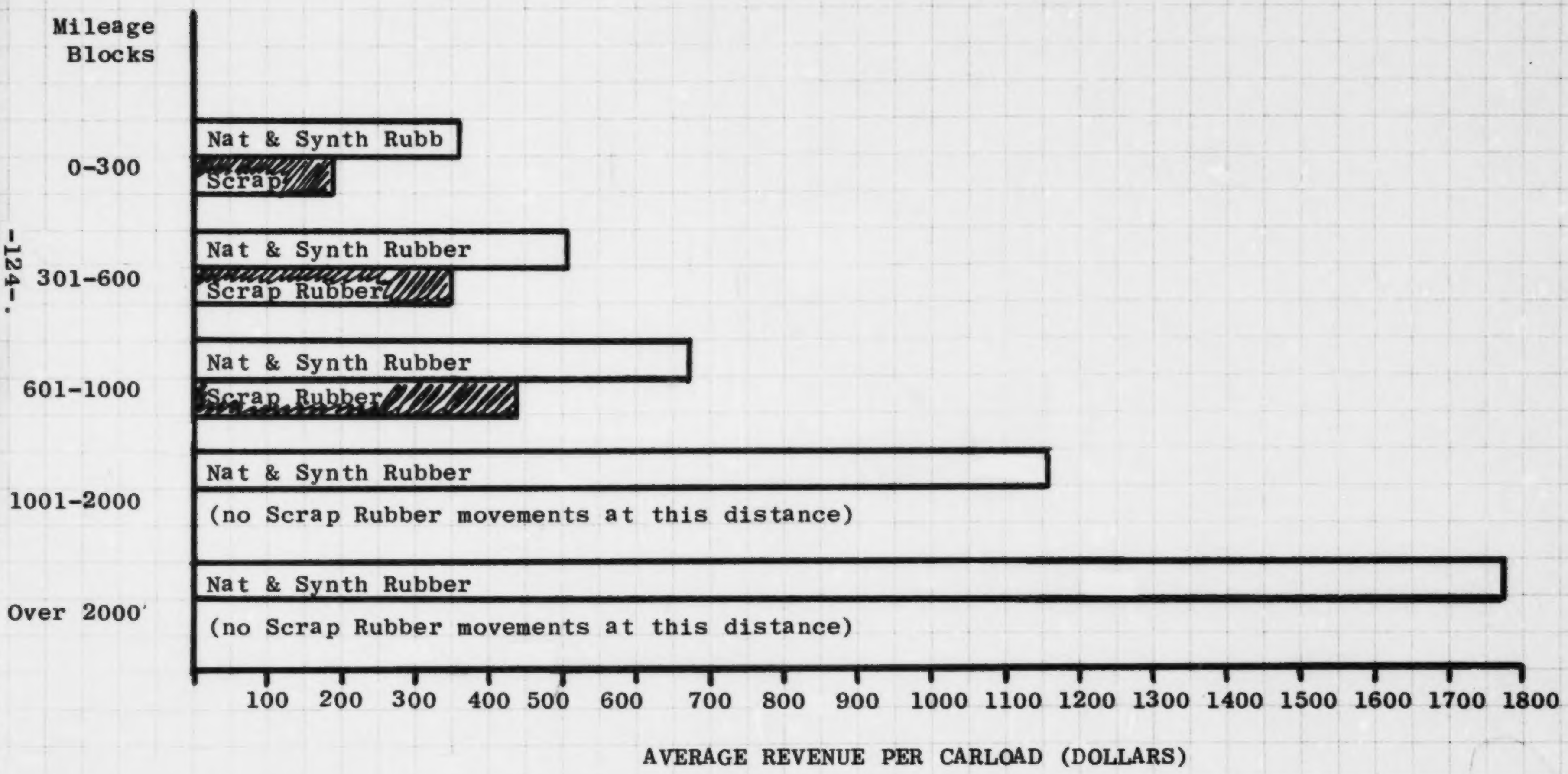
Mileage Blocks	Virgin Commodity: Natural & Synthetic Rubber					Secondary Commodity: Scrap Rubber				
	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var. Cost/ Ton Mile $
0-300	3	360	7.88	.029	.013	3	193	7.72	.037	.027
301-600	8	509	11.30	.027	.012	2	351	15.60	.032	.020
601-1000	7	683	14.95	.025	.012	2	444	11.10	.014	.007
1001-2000	8	1156	20.06	.014	.006	-	-	-	-	-
Over 2000	3	1777	36.77	.017	.006	-	-	-	-	-
All Blocks	29	845	17.23	.018	.008	7	310	10.85	.022	.013

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue ÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 23

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF NATURAL & SYNTHETIC RUBBER AND SCRAP RUBBER



Source: Computed from Master Tables, Appendix A

Revenue per car is a more important indicator of well-being for the railroads than revenue per ton. On this basis, it is evident that the new rubber traffic is far more desirable than the scrap traffic.

This judgment is reinforced by the calculated contribution figures in Table 22 and Figure 24. These data show that on average the new rubber makes a considerably greater contribution per car than the scrap rubber. Contribution as a percent of revenue is not less than 40 percent for the new rubber movements in any mileage block. For the scrap movements, however, the percentage is less than 40 percent in two of the three blocks.

Curiously, for both the new and scrap rubber, contribution as a percentage of revenue rises with distance, contrary to the normal trend. As distance increases, the carriers' costs per ton-mile decline at a greater rate than their unit revenues. In other words, the railroads are not giving the shippers of these commodities the full benefit of the unit cost savings associated with the longer moves. Hence, the farther the movement, the more contribution the railroads earn, both in absolute amounts per car hauled and as a percent of revenue.

The behavior of contribution as a percent of revenue over distance is shown for new rubber in Figure 25 and for scrap rubber in Figure 26. These lines of best fit are drawn from a regression equation. The line for natural and synthetic rubber starts at about 50 percent and rises gradually, whereas the line for scrap rubber starts at about 23 percent and rises to 50 percent over the relatively short spectrum of about 750 miles. While these observations would indicate a rather unusual rate treatment from the variable cost viewpoint,

Table 22

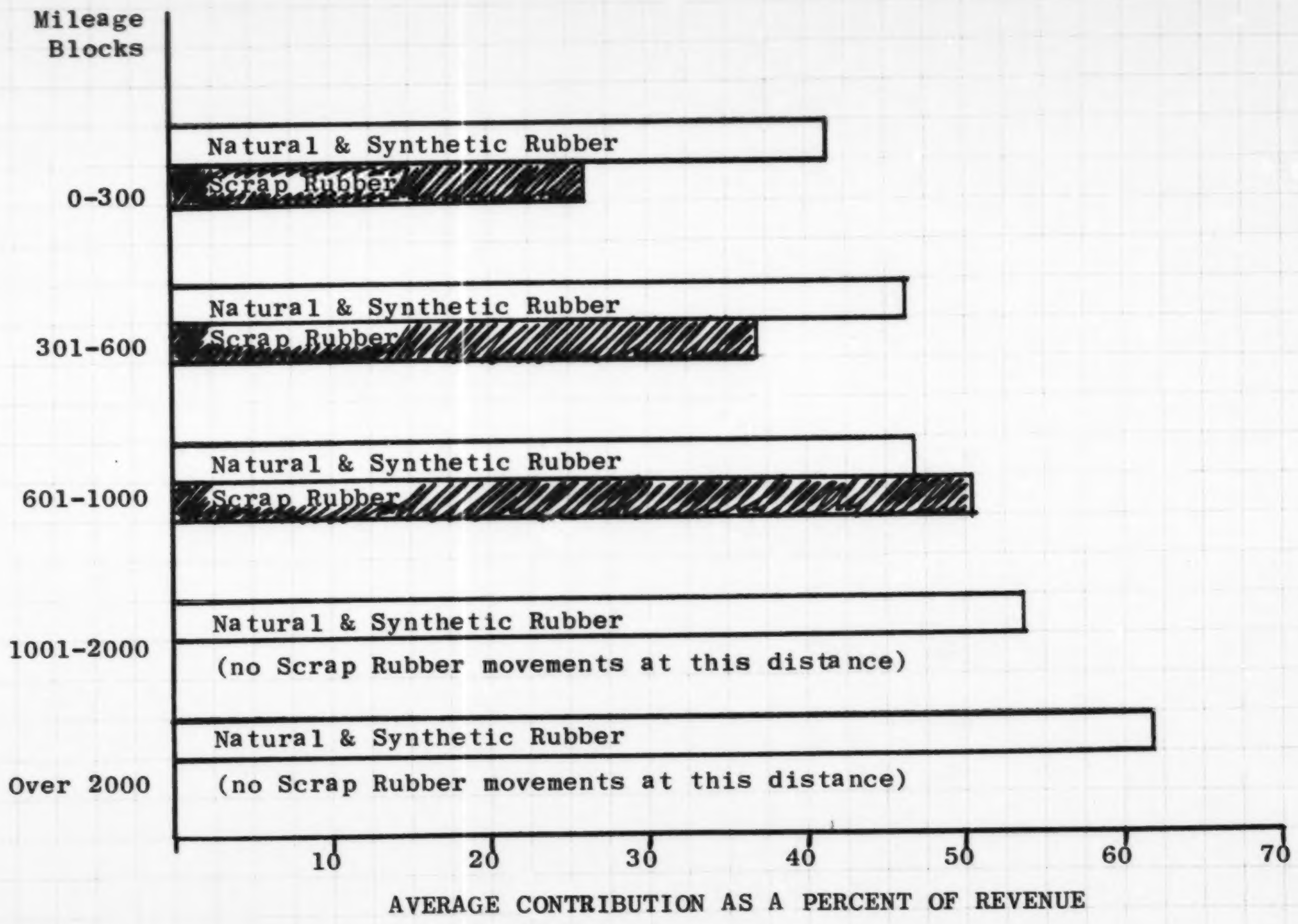
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

	Virgin Commodity Natural & Synthetic Rubber			Secondary Commodity: Scrap Rubber		
Mileage Blocks	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.
0-300	3	150.66	41.9	3	51.67	26.8
301-600	8	238.00	46.8	2	131.00	37.3
601-1000	7	322.14	47.1	2	223.50	50.3
1001-2000	8	618.37	53.5	-	-	-
Over 2000	3	1109.33	62.4	-	-	-
All Blocks	29	444.34	52.5	7	123.43	39.8

Source: Computed from Master Tables, Appendix A.

Figure 24

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF NATURAL & SYNTHETIC RUBBER AND SCRAP RUBBER



Source: Computed from Master Tables, Appendix A

Figure 25

STCC: 0842325 Natural Rubber
STCC: 2821220 Synthetic Rubber

Contribution as a Percentage of Revenue

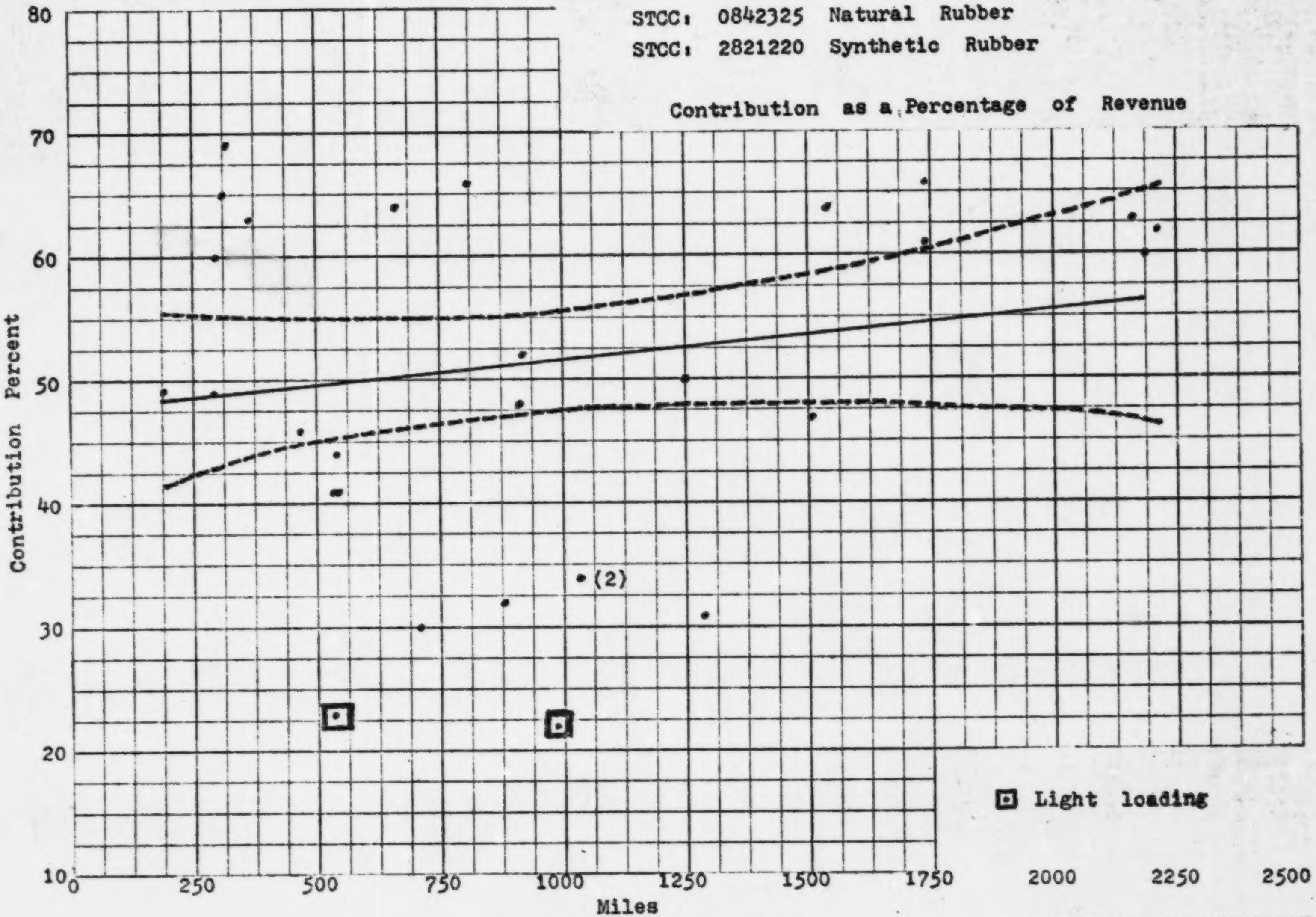
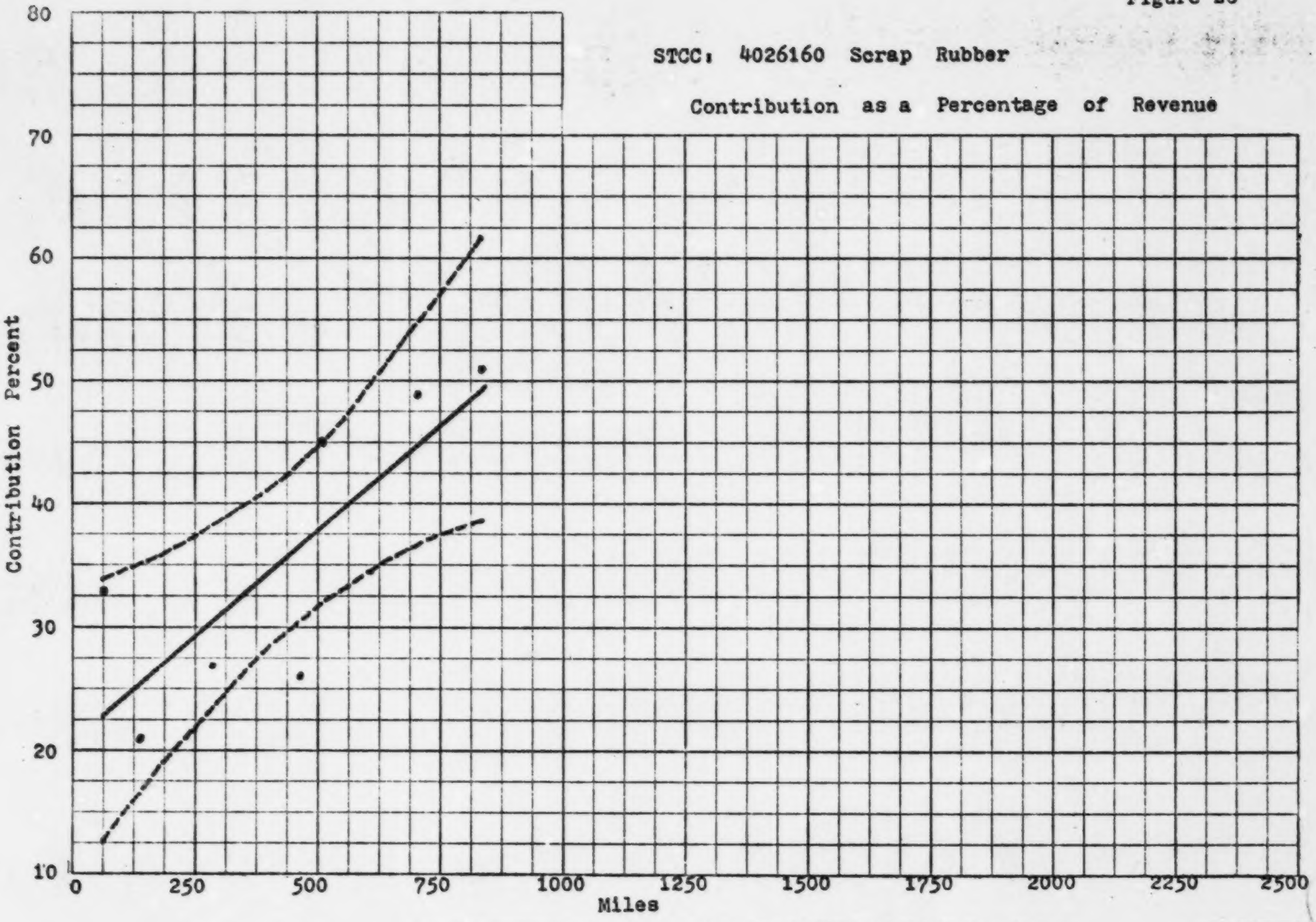


Figure 26

STCC: 4026160 Scrap Rubber

Contribution as a Percentage of Revenue



caution must be expressed not to draw broad conclusions due to the small number of observations. In general, there is no evidence that the secondary material is paying high rates relative to the virgin material.

New vs. Reclaimed Rubber

This analysis is essentially a comparison between a raw material[1] and a semi-manufactured material. It differs from all prior analyses in that a virgin and a competing processed secondary material are being compared. This point must be kept in mind, since freight rates reflect the values of commodities as well as their physical transportation characteristics.

Table 23 and Figure 27 show the behavior of rates and costs over distance. The figures for the new rubber are the same as those shown in the New vs. Scrap Rubber analysis and will not be discussed further.

The reclaimed rubber moves, like the scrap rubber moves, extend only to the third mileage block. Average revenues per car and per ton rise with distance, and revenues and costs per ton-mile decline with distance, as would be expected.

The revenues per car are about the same for reclaimed and new rubber in the first mileage block (1 to 300 miles), but the revenues for the reclaimed are greater in the subsequent mileage blocks. Rates (revenues per ton) are shown to be about the same for the two commodities. Revenue per ton-mile is somewhat higher for reclaimed rubber in the first mileage block, but about the same as for new rubber thereafter. The amounts of contribution, both in absolute terms and as a percentage of revenue, are higher for reclaimed than for new rubber, as seen in Table 24 and Figure 28. For moves of

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[1] A manufactured "raw material" in the case of synthetic rubber.

Table 23

RAILROAD REVENUE AND VARIABLE COST FOR STUDY MOVES BY DISTANCE BLOCKS

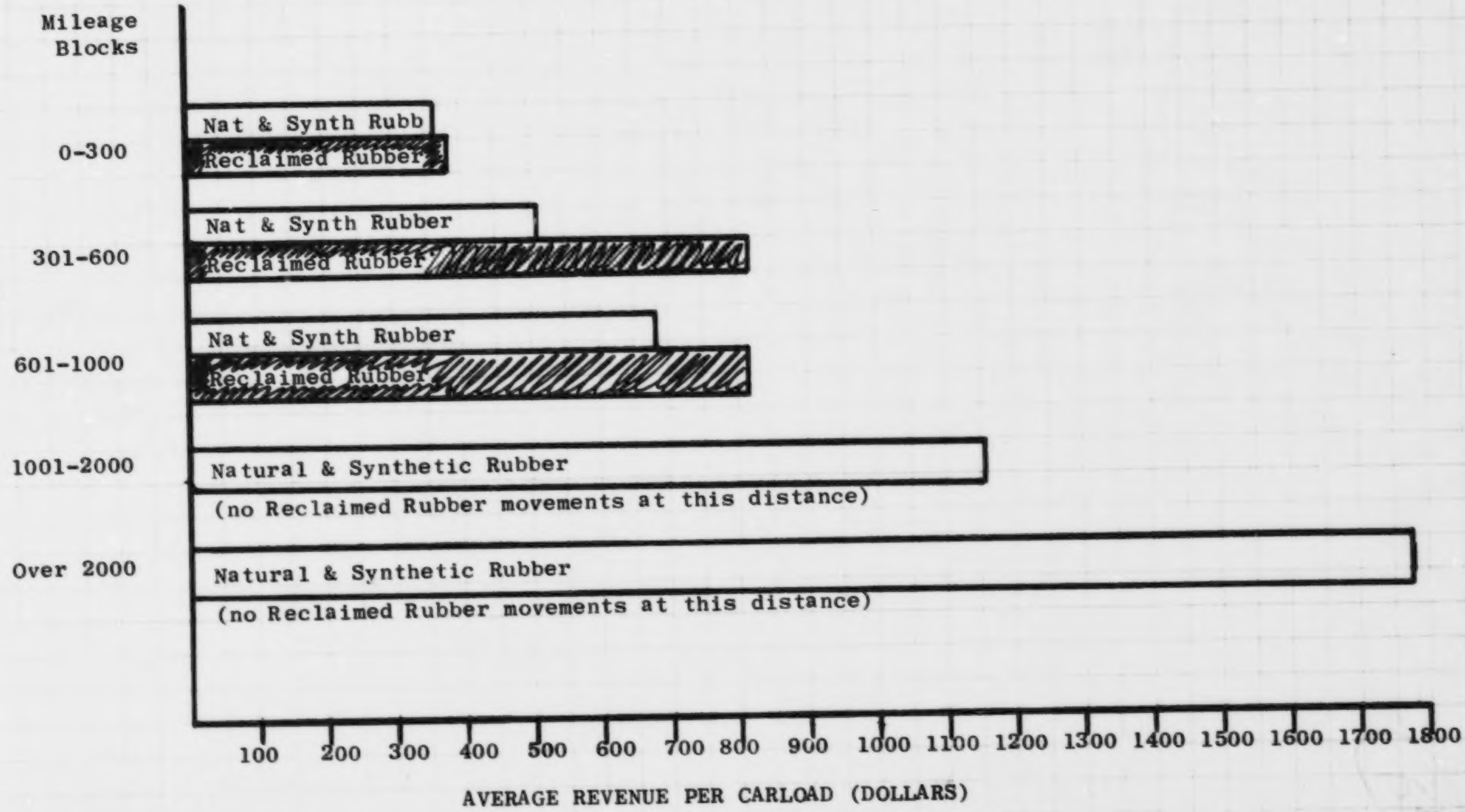
Mileage Blocks	Virgin Commodity: Natural & Synthetic Rubber					Secondary Commodity: Reclaimed Rubber				
	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $	No.of Moves	Average Rev/Car $	Average Rev/Ton $	Average Rev/ Ton Mile $	Average Var.Cost/ Ton Mile $
0-300	3	360	7.88	.029	.013	2	389	7.01	.036	.015
301-600	8	509	11.30	.027	.012	1	815	12.53	.028	.008
601-1000	7	683	14.95	.025	.012	7	815	16.88	.023	.009
1001-2000	8	1156	20.06	.014	.006	-	-	-	-	-
Over 2000	3	1777	36.77	.017	.006	-	-	-	-	-
All Blocks	29	845	17.23	.018	.008	10	730	14.20	.024	.009

Note: Averages for all blocks represent totals for all study moves divided by appropriate total service units, e.g. total revenue ÷ total tons moved, total variable costs ÷ total ton miles, etc.

Source: Computed from Master Tables, Appendix A.

Figure 27

AVERAGE REVENUE PER CARLOAD BY MILEAGE BLOCKS
STUDY MOVES OF NATURAL & SYNTHETIC RUBBER AND RECLAIMED RUBBER



Source: Computed from Master Tables, Appendix A

Table 24

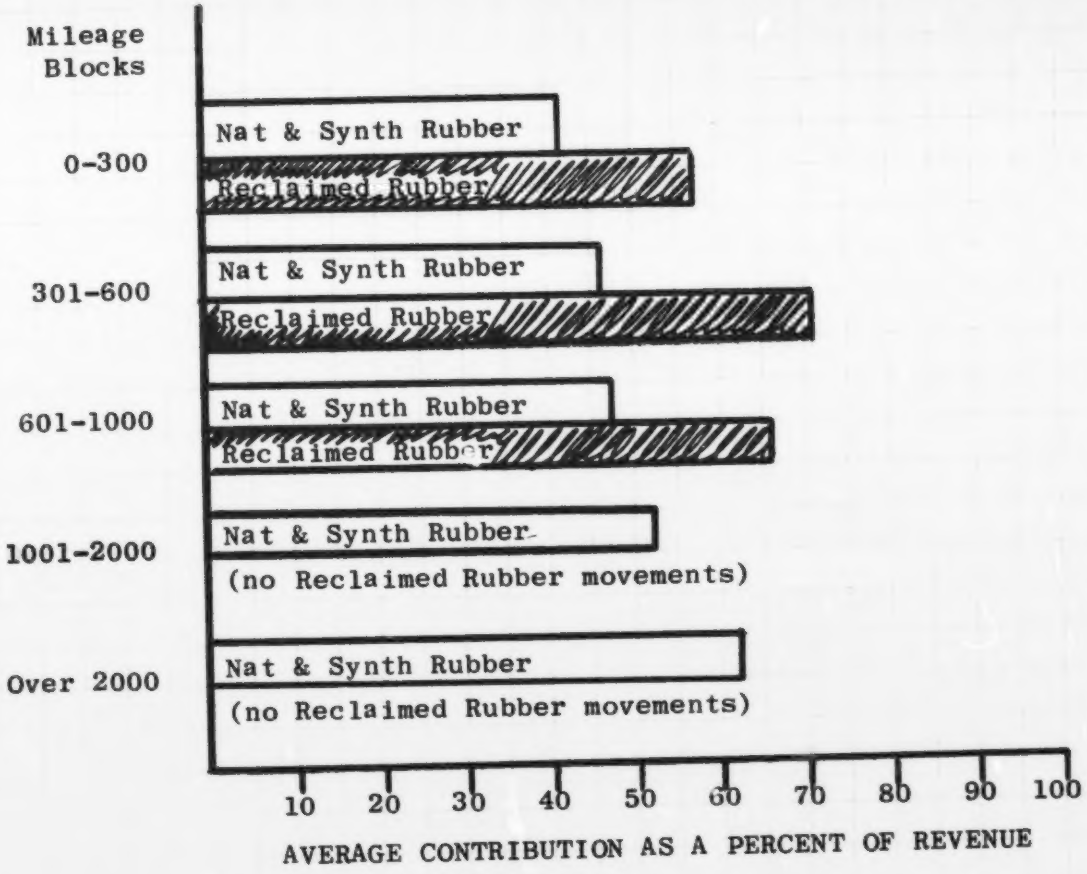
CONTRIBUTION TO RAILROAD REVENUE BY STUDY MOVES IN DISTANCE BLOCKS

Mileage Blocks	Virgin Commodity Natural & Synthetic Rubber			Secondary Commodity: Reclaimed Rubber		
	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.	No.of Moves	Contrib. Per Car $	Contrib.As % of Rev.
0-300	3	150.66	41.9	2	223.50	57.5
301-600	8	238.00	46.8	1	578.00	70.9
601-1000	7	322.14	47.1	7	544.14	66.7
1001-2000	8	618.37	53.5	-	-	-
Over 2000	3	1109.33	62.4	-	-	-
All Blocks	29	444.34	52.5	10	483.40	66.2

Source: Computed from Master Tables, Appendix A.

Figure 28

AVERAGE CONTRIBUTION AS A PERCENT OF REVENUE BY MILEAGE BLOCKS
STUDY MOVES OF NATURAL & SYNTHETIC RUBBER AND RECLAIMED RUBBER



Source: Computed from Master Tables, Appendix A

reclaimed rubber in excess of 300 miles, the contribution per car exceeds $500, a rather large amount relative to gross revenue. Contribution averages 66 percent of revenue for all moves.

The line of best fit for the regressed contribution as a percentage of revenue in Figure 29 slopes downward with distance, but reflecting the figures noted above is at a rather high level.

Analysis By Destination Territory

Table 25 shows prices paid, per car and per ton-mile, by receivers in the respective destination territories.

The data for the natural and synthetic rubber demonstrate that transportation prices for those commodities are not based on distance alone, but also reflect territorial differences. With the exception of receivers in Territory 4, all the consignees are paying essentially the same amount per ton-mile. If these rates followed a uniform pattern, receivers in Territory 5 would be charged substantially less per ton-mile than the average, while those in Territory 2 would be charged more.

Contrarily, the rates for scrap appear to be fairly well influenced by distance, rather than territory. Receivers closest to shipping points pay the largest amount per ton-mile and the least amount per car, whereas those farthest from the shipping points, those in Territory 2, pay the largest amount per car and the least amount per ton-mile.

While distance is an important factor in the rates for reclaimed rubber, there are some territorial inconsistencies. Receivers in Territory 5, who are recieving reclaim from the most distant points, are paying the highest amounts per car

Figure 29

STCC: 3031190 Reclaimed Rubber

Contribution as a Percentage of Revenue

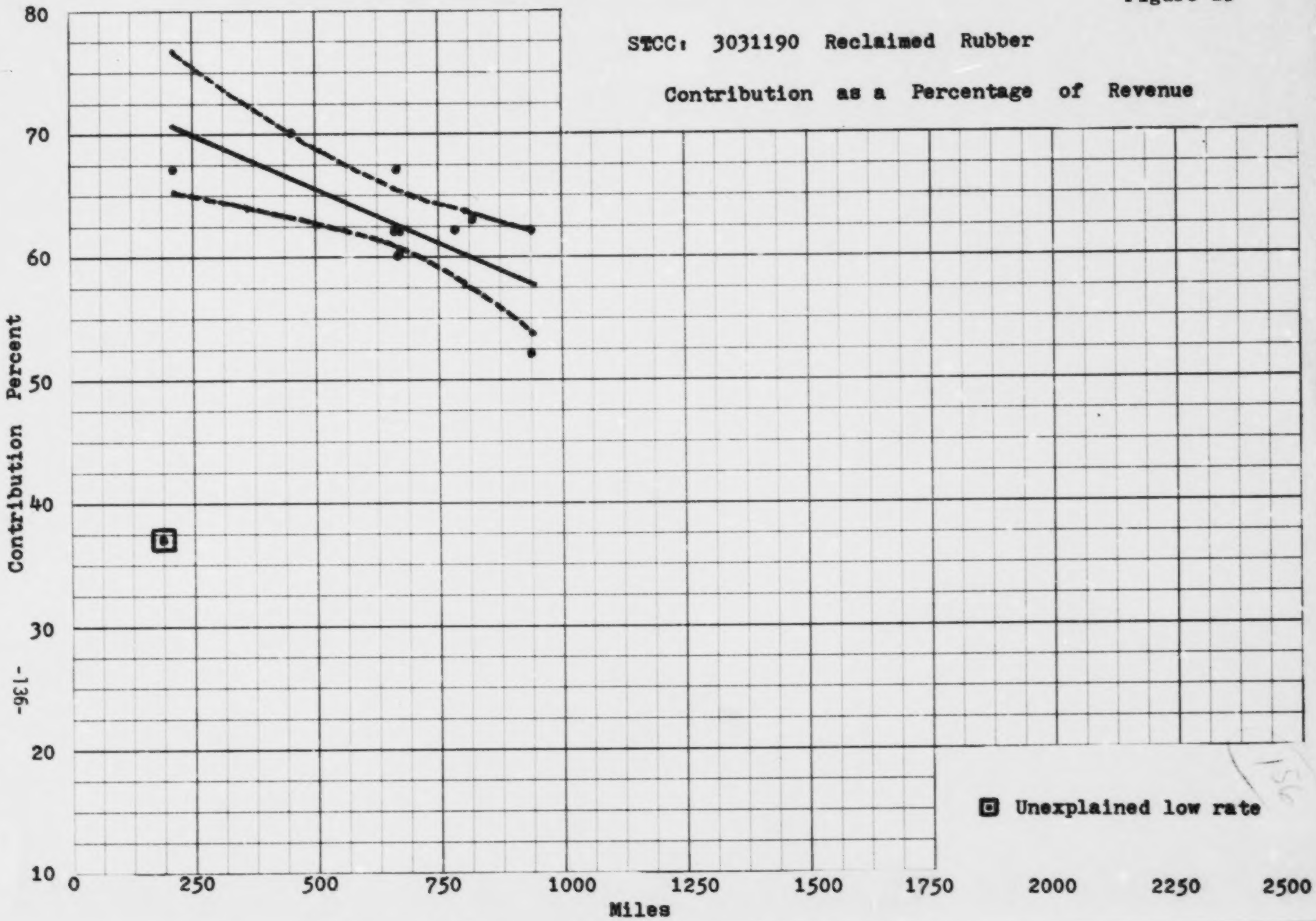


Table 25

Rate Differences By Destination Territories
Natural, Synthetic, Scrap and Reclaimed Rubber

	NATURAL & SYNTHETIC			SCRAP			RECLAIMED		
Dest. Terr.	Avg.Rev. Per Car	Avg. Haul (mi.)	Avg.Rev. Per Ton-Mile	Avg.Rev. Per Car	Avg. Haul (mi.)	Avg.Rev. Per Ton-Mile	Avg.Rev. Per Car	Avg. Haul (mi.)	Avg.Rev. Per Ton-Mile
1	$ 866	857	.016¢	$264	404	.032¢	$ 556	483	.028¢
2	552	487	.015¢	362	624	.021¢	860	800	.022¢
3	855	1,220	.014¢	--	--	--	1,228	927	.025¢
4	414	709	.023¢	183	179	.128¢	675	869	.026¢
5	1,762	2,023	.016¢	--	--	--	1,520	2,250	.016¢

Source: Computed from 1969 One Percent Waybill Sample.

and the lowest amounts per ton-mile, and those in Territory 1, closest to the shipping points, are paying the least per car and the highest ton-mile rates, as might be expected. On the other hand, the average hauls in Territories 2 and 4 are about the same, but the rates per ton-mile are 20 percent different.

5.7 Findings

The rates for short and medium range movements of new rubber (natural and synthetic) appear to be consistently related to costs, with contributions of about 45 percent of revenues, on average. For the moves over 1,000 miles, however, the rates appear to be relatively high. At that distance the rate of contribution is still rising, whereas it could be expected to be declining. Rates per ton-mile do not drop appreciably over distance, another indication that rates are held at rather high levels.

Scrap rubber rates are relatively low compared with new rubber, when measured in terms of revenue per car and net contribution.

Reclaimed rubber rates make generous contributions, averaging 66 percent of revenues for the ten study moves. In relation to the other rubber commodities, the rates for reclaimed rubber seem to be high, costs considered.

Concluding Overview

Five virgin and six secondary commodities were discussed in the preceding sections of this chapter from a rate-cost viewpoint. These analyses indicate widely diverse and inconsistent results. To some extent, this is not surprising, because a) cost considerations are but one factor in the ratemaking process, and b) the costing procedures do not reflect the specific characteristics of each movement, although they do reflect the average handling experienced by the types of equipment utilized.

The use of averages, regardless of the sample size and its statistical significance, though helpful in gaining an overview, has the disadvantages of a mathematical medium that obscures those observations which could be most significant for some groups of shippers and consignees. Nevertheless, the study does permit some meaningful conclusions.

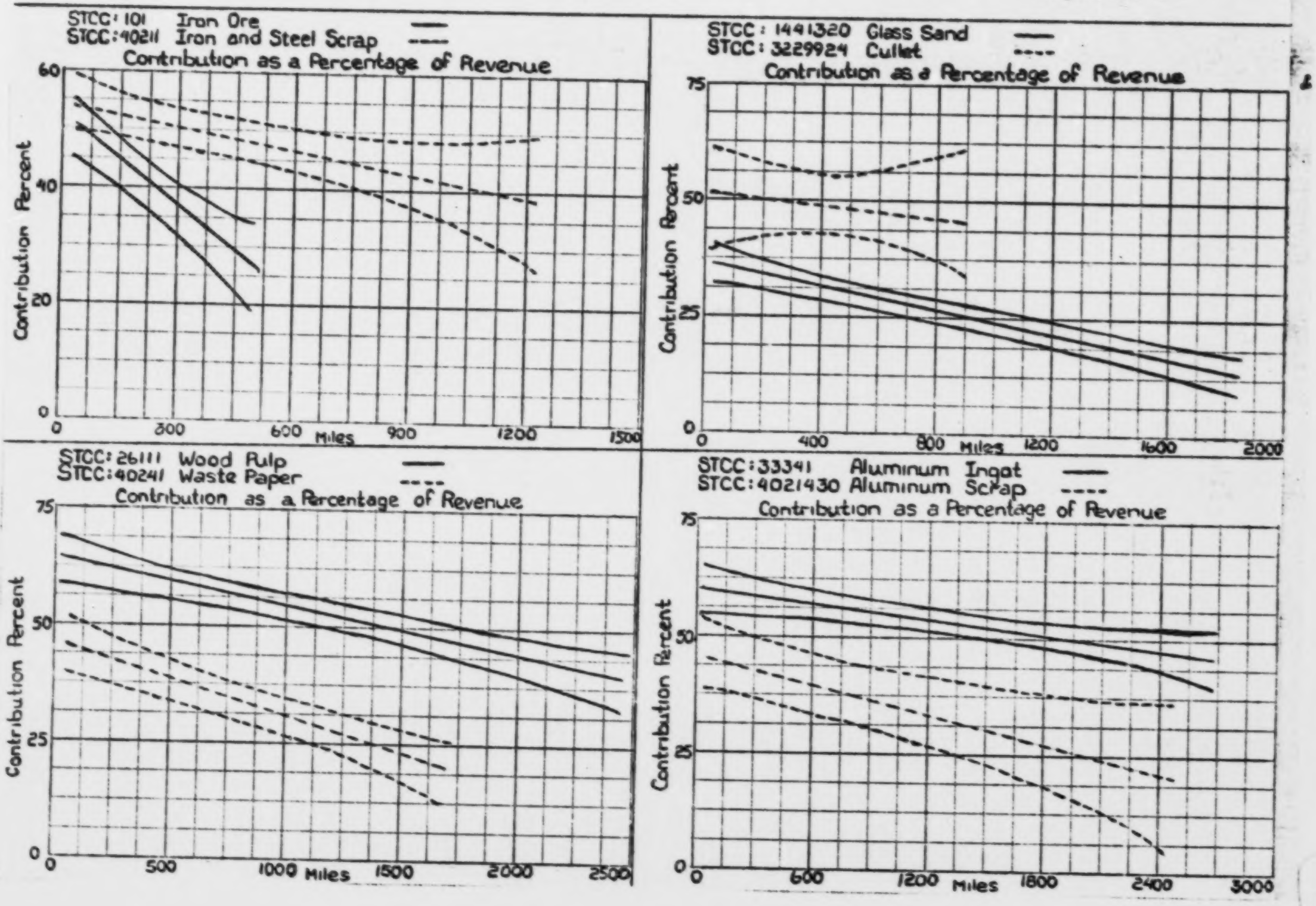
In three pairs of competing commodities, the rates for secondary materials were shown to be priced, on average, less favorably to the users than their virgin counterparts. Iron and steel scrap, cullet, and reclaimed rubber movements contribute appreciably more to the railroads' net revenue than do iron ore, glass sand, and natural and synthetic rubber. Figure 30, depicting the lines of best fit and their confidence bands for each pair of commodities, provides a ready illustration.

While for the shortest moves both ore and scrap make about the same contribution, around 50 percent, ore pricing reflects a sharp drop as distance increases, while scrap rates tend to stay higher. The decline in the contribution rate for long haul scrap is so modest that the contribution rates for these hauls are higher than those for the shortest ore movements.

Nevertheless, it should be remembered that the preponderance of the ore and scrap moves are less than 200 miles in length, and that in this distance range the two commodities were found to be treated fairly equitably on the basis of the herein applied costing procedures. The suspicion expressed that a more concise costing procedure for the short scrap movements might reveal a less equitable situation should also be borne in mind.

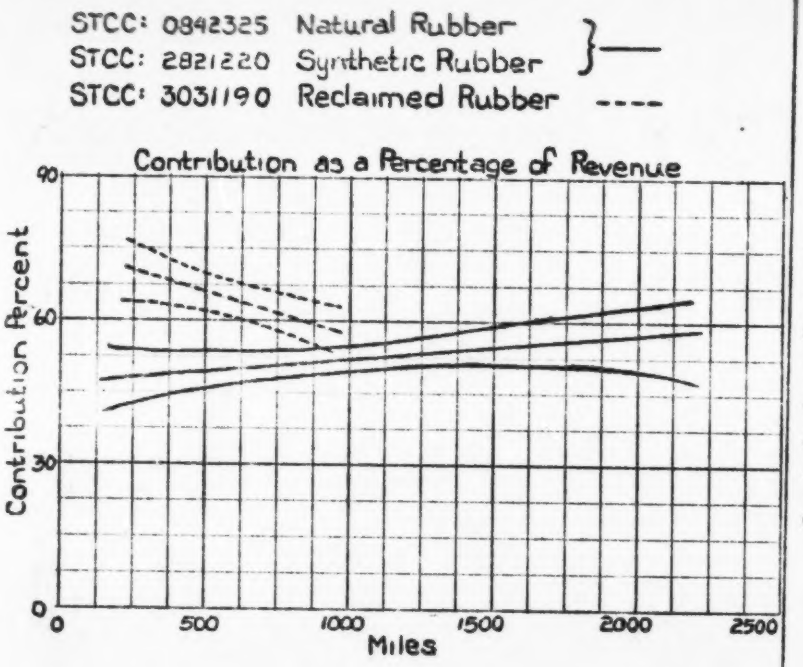
Contribution as a Percentage of Revenue, Study Commodities

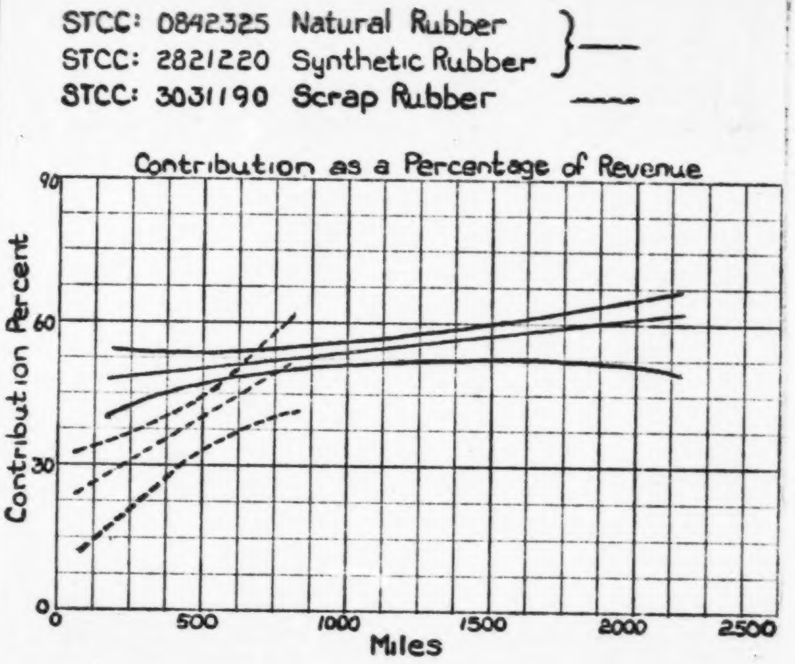
Figure 30
Page 1 of 2



Contribution as a Percentage of Revenue, Study Commodities

Figure 30
Page 2 of 2





The comparison for glass sand and cullet is similar except that the rate of contribution for cullet is significantly higher than for sand at all lengths of haul. The average contribution for all cullet moves was more than twice the percentage of contribution derived from glass sand.

The limited number of study moves for reclaimed rubber show an average contribution rate which is considerably more than for any other secondary commodity. For all lengths of haul combined, the average contribution per car for the reclaimed rubber was $483 compared with $256 for the natural and synthetic rubber, a ratio of almost two to one. The contribution rates were 66.2 percent of revenue for the secondary commodity and only 46.1 percent for the virgin material.

The comparison of new and scrap rubber is limited by the fact that only seven moves of the secondary commodity were analyzed. These seven, though, show a progression which would tend to discourage the longer hauls. While beginning with a contribution rate that is lower than that for any study commodity, the rate rises sharply thereafter and is similar to the rates for natural and synthetic rubber.

Aluminum scrap and waste paper contribute on average less than their virgin materials counterparts. Thus, this measure would suggest that these rates are relatively low. For both pairs, the rates reflect the typical decline in contribution percentage as distance increases. Further, the contribution rates at absolute levels are at the lower end of the contribution spectrum.

Another useful overview, from the national standpoint, is provided by the analyses of average rates by destination territory. Though these ignore rail cost considerations, they provide an indication of the average price paid by the consumer of the transport services. Simplifying further and viewing the picture as a single national average for each pair of commodities based on the 1969 traffic consist, as contained in the One Percent Waybill Sample, it is possible to illustrate the differences paid by consumers of the competing commodities per ton of traffic hauled, regardless of differences in length of haul. Expressed as a percentage of the average rate per ton for the virgin counterpart commodity, the following values were computed for the secondary commodities:

Iron and Steel Scrap	196
Cullet	193
Reclaimed Rubber	127
Scrap Rubber	98
Aluminum Scrap	96
Waste Paper	64

It is particularly interesting to note that some correspondence exists between the above results and the contribution analyses. The three commodities for which shippers pay more than the average rate of their virgin material counterparts, are also the three secondary materials for which higher contribution rates were calculated.

It will be remembered that our analyses were based on 1969 revenues and cost factors. Since that time, four general rate increases have been authorized by the I.C.C. The last two, in Ex Parte 267B and 281B, differentiated in the increase percentages by rate territories and some commodities. The aggregate increases authorized on average tend to maintain about the same differences between the virgin and secondary commodities as were shown for the 1969 rate levels. For example, the increases applicable on iron ore and scrap are as follows:

Ex Parte 262	6 percent
Ex Parte 265	6 percent
Ex Parte 267	13 percent iron ore,[1] 11 percent scrap
Ex Parte 281	5 percent
Total	33 percent iron ore, 31 percent scrap

Applying these increases to the average base (the average rate per ton paid by consumers in 1969), results in average ore and scrap rates with approximately the same difference as was calculated for 1969. From this it can be concluded that on average the relationship in rates for virgin and secondary materials has not been materially changed by the rate increases authorized by the I.C.C. since 1969.

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[1] Weighted average for all territories; the increase ranged from 6 to 14 percent, depending on territory.

V. RATE STRUCTURE ANALYSIS

Principles

It is a well-established fact that the heavier the lading per railcar, the lower the costs for transport per ton. Railroads have long recognized this economic principle and have reflected it in their so-called incentive rates. These rates are intended to motivate shippers to load rail cars more nearly to their full capacity. The incentive is a reduced rate per ton for each increment of load above the minimum.

This concept is similar to quantity discounts in the pricing of most products and services. The purchaser of a large quantity of steel will usually pay less per ton than the purchaser of a small quantity. The incentive price is usually intended to benefit both the buyer and the seller. This is brought about by the supplier passing on to the consumer only a portion of the savings realized from production at larger scale.

Suppliers of transportation services not only recognize these principles, but use them effectively. Railroads in particular have been increasingly conscious of the economies of volume resulting from multiple heavily loaded car movements. The increasingly popular unit train for bulk commodities is the extreme example of the application of volume pricing.

Incentive pricing has been applied by the railroads to the study commodities in varying degrees. How the benefits are divided between the shipper and the carrier can readily be measured. The most appropriate measure for this analysis, in our judgment, is to compare the cost saving to the railroad of the heavier load with the rate saving to the shipper of the incremental traffic. These measures can then be related to determine what share of the reduced cost the carrier is passing on to its customer.

It is essential to recognize that the various rate bureaus have different attitudes toward the sharing of cost reduction. This study clearly indicates that greatly different results exist in the rate-cost relationships applied in the various rate territories.

Methods of Analyses

Tables in the following industry sections show the results of the calculations made. These analyses were performed in the following manner:

a. Increases in minimum weight levels were expressed as percentages of the lowest minima. Example: for a minimum weight structure of 50,000, incentive loads of 75,000 and 100,000 pounds would be described as 50 percent and 100 percent increases over the minimum.

b. Rates associated with successive minimum weight levels were expressed as percentage reductions from the rate for the least minimum. Example: rate of $4 on a 75,000-pound minimum, compared with $6 on a 50,000-pound minimum, is described as a 33.3 percent reduction.

c. Unit costs for moves loaded at the successive minimum weight levels were expressed as percentage reductions from the unit costs associated with the move at the lowest minimum weight.

d. Finally, the percentage of cost reduction was divided by the percentage of rate reduction at each successive

> minimum weight level to obtain the ratio of cost to rate reduction; put simply, where the resulting figure is more than 1.0, the carrier is passing on to the shipper less than the full amount saved due to the heavier lading.

These computations were made for rates published by three different Bureaus for each commodity, except in cases of data insufficiency, or where the rate structure does not provide for incentive ladings per car, as in the case of iron ore.

These analyses show differences among the bureaus' incentive pricing policies, and in the pricing treatment accorded to competing commodities.

The limited number of rates studied herein indicate that existing incentive rate structures are more advantageous for some commodities than they are for others.

It is noteworthy that the I.C.C. in its recent order in Ex Parte 281 (Environmental Matters) admonished the railroads to give greater consideration to incentive rates for secondary commodities.

Findings

Iron and Steel

Iron Ore

There are no incentive loading provisions for single cars in iron ore tariffs, since ore is routinely loaded to car capacity anyway. Tariffs merely specify that a car be loaded full, or to 90 percent of the car's marked capacity, or to some weight level that approximates a car's limit.

However, the shipper is given a rate incentive to load several cars instead of one. Tariffs commonly provide one rate for single cars and another for 1,500 (or 5,000 or 10,000) aggregate tons. Western Trunk Line railroads offer a multiple-car rate with both a minimum and maximum; a single shipment must weigh at least 6,000 gross tons (of 2,240 pounds), but must not exceed 7,500 gross tons to qualify for the applicable rate. The Southern Freight Tariff Bureau publishes a single-car rate with a 100,000 pound minimum and a multiple-car rate (1,800 net ton aggregate minimum) that is approximately 85 percent of the single-car rate. The Pacific Southcoast Freight Bureau offers two multiple car rates: one applicable to a 1,500 gross ton shipment, which is 79 percent of the single-car rate; and another applicable to a 5,000 gross ton shipment, at about 70 percent of the single-car rate.

Iron and Steel Scrap

As with ore, the rate structure for ferrous scrap varies among territories. The Trunk Line-Central Territory Railroads maintain rates at minimum weight levels of 44,800, 80,000, and 112,000 pounds, the latter being available in some cases only for five-car shipments. Weight minimums for five-car lots vary from 250 to 500 gross tons. Also SFA, SWL, and WTF have some multiple car rates.

The Southern Freight Association publishes rates at minima of 50,000, 80,000, and 100,000 pounds, the latter being applicable on five-car shipments.

In the west, some lower minima are available. The Pacific Southcoast Freight Bureau publishes minima of 30,000, 60,000, 80,000, and in some cases, 100,000 pounds. Southwestern Lines have a similar minimum weight structure, with minima of

30,000, 50,000, 75,000, and 100,000 pounds. The 100,000-pound rates are available in some cases if a car is loaded to full visible capacity and weighs at least 80,000 pounds.

The Western Trunk Line Tariff Bureau has a similar rate arrangement, offering 80,000-pound rates to those shippers who fill a car to full visible capacity and a lading of at least 60,000 pounds.

Accessorial charges for ferrous scrap include a turnover charge, applicable when a loaded car is tendered to a carrier without designation of final destination. This current charge is $10.80 per car in Official Territory. Beginning with the Southern Freight Association in 1969, railroads increasingly have published charges for weighing. Those charges now range from $12 to $20 per car.

Comparison Between Ore and Scrap

No comparison between iron ore and iron and steel scrap was possible because ore, except in rare and insignificant cases, moves under rates requiring fully loaded cars, and, in most cases, multiple cars. However, an analysis of selected incentive rates for iron and steel scrap was made. Table 26 shows the appropriate figures. It can be seen that for large increases in ladings, rate reducations were sizable, but often less than half of the associated cost reduction. A consistent cost-sharing principle was applied by the Southwestern lines; at three successive incentive rate levels, the bureau reduced the rate by two-thirds of the amount saved. On average, a lesser share of the savings was

Table 26

SELECTED RATE-COST RELATIONSHIPS FOR LADING ABOVE CARLOAD MINIMA

Secondary Commodity: Iron & Steel Scrap

Lading % above minimum	Rate Reduction % of minimum	Cost Reduction % of minimum	Ratio Cost Reduction/ Rate Reduction
	Rate Bureau		
	T.L.C.T.R.		
80.0[1/]	13.3	40.4	3.0
150.0	48.4	54.6	1.1
	S.W.L.		
66.6	24.0	35.9	1.5
153.3	35.3	53.3	1.5
233.3	41.9	62.9	1.5
	P.S.F.B.		
100.0	18.5	46.2	2.5
166.6	25.3	57.8	2.3
233.3	35.4	64.7	1.8

[1/] Calculated as follows: minimum car-load is 44,800 lbs., next minimum is 80,000 lbs., e.g., 35,200 inverse ÷ 44,800 = 78.6%, rounded to 80%.

Source: Official Tariffs on file with I.C.C. applicable to selected study moves; and study cost calculations.

Note: For description of rate bureau abbreviations, see glossary at end of this chapter.

passed on to shippers using TLCTR and PSFB rates. In only one case was the rate reduced by almost as much as the costs saved, resulting in a cost/rate reduction ratio of 1.1. By contrast, the remaining observations had ratios ranging from a low of 1.8 to a high of 3.0.

Paper

Woodpulp

Weight minima of 50,000, 100,000, and 120,000 pounds apply to woodpulp in at least three territories: SFTB, SWL, and TLCTR. In the two latter territories, the rates applicable to the 120,000 pound minimum level are restricted to shipments moving in cars that do not exceed 42 feet.

Some of the pulp shipments in the study moved under individual carrier rates. The Maine Central maintains a tariff of per-car charges, which again are applicable only to shipments in cars not exceeding 42 feet. The Soo Line has a scale of pulp rates with minima of 50,000, 80,000, and 90,000 pounds.

Waste Paper

The minimum weight levels are lower for waste paper than for pulp, and they are fairly consistent among the different territories.

TLCTR minima are 40,000, 50,000, and 80,000 pounds. WTL and SWL offer identical minimum weight requirements--40,000, 50,000, 60,000, and a higher minimum weight variable with car size: 80,000 pounds if the car is 40 feet 7 inches or less, and 100,000 pounds if the car is larger.

The Soo Line tariffs provide for minima of 30,000, 40,000, and 80,000 pounds.

Comparison Between Woodpulp and Waste Paper

Table 27 shows that carriers offer minima for pulp that have a greater weight range than the waste paper tariffs. Pulp tariffs have minima that range up to 140 percent of the lowest minimum weight per car, while waste paper tariffs range from 25 to 100 percent of the lowest minima.

Without exception, the rates examined drop in relation to cost reductions at least by as much for waste paper as they do for pulp for the same percentage increases in lading.

In TLCTR territory the rates studied show that doubling of the minimum lading in both commodities results in comparable rate and cost reductions. In SWL territory, however, a similar comparison shows that waste paper is accorded a greater rate reduction than woodpulp, with waste paper getting over half the costs saved, but pulp only 41 percent.

Railroads in the South appear to be keeping a disproportionate share of cost savings on pulp movements compared with carriers located elsewhere, with cost/rate reduction ratios of 3.6 and 2.4.

These data show that waste paper is accorded a slight advantage in the incentive rate structure as compared with woodpulp.

Glass

Glass Sand

Most rates for glass sand are published in individual carrier tariffs, applicable only between two named points. This makes any attempt at territorial analysis impractical.

Glass sand, like iron ore, almost always moves in cars loaded to capacity, so that there are few incentive loading

Table 27

SELECTED RATE-COST RELATIONSHIPS FOR LADING ABOVE CARLOAD MINIMA

Virgin Commodity: Woodpulp				Secondary Commodity: Waste Paper			
Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.	Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	Rate Bureau				Rate Bureau		
	T.L.C.T.R.				T.L.C.T.R.		
100.0	21.3	41.6	1.9	25.0	9.2	17.3	1.9
140.0	28.8	49.0	1.7	100.0	23.0	43.2	1.9
	S.W.L.				S.W.L.		
100.0	16.6	40.6	2.4	25.0	9.5	16.8	1.8
140.0	24.3	47.5	1.9	100.0	23.3	42.0	1.8
	S.T.F.B.				W.T.L.		
80.0	10.0	36.3	3.6	25.0	9.9	17.4	1.8
140.0	19.5	47.7	2.4	100.0	23.6	43.6	1.8

Source: Official Tariffs on file with I.C.C. applicable to selected study moves; and study cost calculations.

Note: For description of rate bureau abbreviations, see glossary at end of this chapter.

provisions for single cars. Most tariffs state one minimum level, either a specific weight or a percentage of marked capacity (90 or 95 percent). TLCTR tariffs, for example, generally specify a minimum weight of 100,000 pounds or 95 percent of marked capacity of the car.

Cullet

Lower minimum levels are available for cullet than sand. Most TLCTR tariffs provide rates at the 50,000 and 100,000 pound levels. Some specify a minimum lading of 90 percent of marked capacity, but not less than 100,000 pounds. Likewise, SFTB tariffs specify minima of 50,000 and 100,000 pounds. IFA publishes cullet rates applicable to shipments loaded to 90 percent of marked capacity.

Comparison Between Glass Sand And Cullet

As noted above, most glass sand tariffs specify only a single minimum weight level for a car. The two glass sand cases selected for analysis in Table 28, therefore, are not representative for this virgin commodity; they are shown merely as examples of a segment of the rate structure. The SFTB case signifies that the carriers are keeping most of the cost savings resulting from higher ladings of sand; however, SFTB publishes numerous point-to-point rates, designed for particular shippers, with only a single, but high, minimum weight level and relatively low rate.

The rate structures for cullet show that the TLCTR and IFA carriers are passing on to shippers more than half the savings in unit costs attributable to heavier ladings. But SFTB carriers are giving cullet shippers only about a quarter

Table 28

SELECTED RATE-COST RELATIONSHIPS FOR LADING ABOVE CARLOAD MINIMA

Virgin Commodity: Glass Sand				Secondary Commodity: Cullet			
Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.	Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	Rate Bureau				Rate Bureau		
	S.F.T.B.				S.F.T.B.		
90.0	6.4	36.1	5.6	100.0	10.4	42.7	4.1
	C.N.J. 1/				T.L.C.T.R.		
40.0	32.7	25.4	0.8	100.0	26.3	43.9	1.7
					I.F.A.		
				80.0	24.3	41.1	1.7

1/ Central of New Jersey. Comparison between a 50,000 pound rate and a 70,000 pound/2 car rate.

Source: Official Tariffs on file with I.C.C. applicable to selected study moves; and study cost calculations.

Note: For description of rate bureau abbreviations, see glossary at end of this chapter.

of such savings. Once again, these wide differences confirm that there is no master plan of ratemaking among the railroads.

Aluminum

Primary Aluminum Ingot

Minimum weight requirements for shippers of primary ingot vary widely from region to region. Some have rates available at the 30,000 pound level, while others must meet a 50,000 pound minimum to get a commodity rate. Some shippers have a 140,000 pound rate and others have no incentive to load over 100,000 pounds.

TLCTR tariffs generally specify minima of 30,000 and 50,000 pounds. SWL has minimum levels of 30,000, 50,000, and 100,000 pounds. SFTB publishes rates applicable to those levels and for a 140,000 pounds minimum. In the Far West, PSFB maintains rates at minima of 50,000, 80,000, and 100,000 pounds, and NPCFB offers rates at minima of 50,000 and 140,000 pounds.

Aluminum Scrap

Aluminum scrap tariffs generally specify at least minimum weight of 40,000 pounds and another minimum of 60,000 pounds. TLCTR and IFA maintain rates at 40,000, 60,000, and 80,000 pound minimum levels. WTL has a similar structure. PSFB and TCFB offer rates at a variety of minima, depending variously on car size and destination.

Comparison Between Primary Ingot And Scrap

Table 29 shows that shippers of primary ingot have a very favorable incentive rate structure in PSFB territory. At both incremental minimum levels, the rate reduction is almost as large as the unit cost reduction.

The incentive to load heavier is not so great in TLCTR territory, where the unit cost reduction is almost three times the rate reduction, or in SFTB, where the cost reduction is 5.6 and 1.7 times the rate reduction for the second and third minimum weight levels, respectively.

Outside of TCFB territory, it appears that shippers of aluminum scrap have relatively little incentive to load cars beyond the least minimum level. In the cases shown in Table 29, TLCTR railroads give shippers a 7.8 percent rate reduction for a 50 percent increase in lading, and a 16.2 percent rate reduction for a 100 percent increase in lading. IFA carriers maintain a very similar rate structure. In both those territories, shippers receive only a small part of the unit cost savings associated with larger ladings. The ratio of cost/rate reductions in TLCTR territory is 3.8 and 2.7, while in IFA it is 3.3 and 2.5.

Overall, the examples analyzed show the rate structure for aluminum ingot to be more advantageous than the structure for aluminum scrap.

Rubber

Natural and Synthetic Rubber

Most railroad tariffs do not distinguish between synthetic and dry natural rubber. TLCTR publishes incentive rates for new rubber moving in domestic service. One rate applies to

Table 29

SELECTED RATE-COST RELATIONSHIPS FOR LADING ABOVE CARLOAD MINIMA

Virgin Commodity: Primary Aluminum Ingot				Secondary Commodity: Aluminum Scrap			
Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.	Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	Rate Bureau				Rate Bureau		
	T.L.C.T.R.				T.L.C.T.R.		
66.6	12.8	35.5	2.8	50.0	7.8	29.6	3.8
				100.0	16.2	44.4	2.7
	S.F.T.B.				I.F.A.		
66.6	6.1	34.1	5.6	50.0	9.0	29.8	3.3
233.3	35.7	61.2	1.7	100.0	17.9	44.6	2.5
	P.S.F.B.				T.C.F.B.		
166.6	46.7	53.5	1.1	50.0	14.0	22.6	1.6
233.3	51.5	60.0	1.2				

Source: Official Tariffs on file with I.C.C. applicable to selected study moves; and study cost calculations.

Note: For description of rate bureau abbreviations, see glossary at end of this chapter.

a 30,000 minimum weight and another lower rate applies to all weights in excess of 30,000 pounds. The TLCTR import rates are applicable only to shipments of 70,000 pounds, and no incentive rates are published.

Rates published by TCFB and SWL from Texas points (the primary origin for synthetic rubber) apply to minimum weight levels of 80,000, 100,000, and 140,000 pounds. In addition, some TCFB tariffs offer rates applicable to a 60,000 pound minimum.

Reclaimed and Scrap Rubber

Incentive rates are also found in tariffs for reclaimed rubber. TLCTR tariffs provide a rate for reclaim at a minimum weight of 50,000 pounds and a lower rate for ladings in excess of that minimum. In some tariffs, a third rate applies to shipments of 100,000 pounds or more.

Scrap rubber rates vary considerably from region to region, and in most cases include only a single minimum weight level, indicating that rates are "tailor made" to meet the needs of a particular shipper. For example, the rate search revealed at least three different rate structures for scrap rubber in three areas of TLCTR territory.

Few incentive rates for scrap rubber were found to exist in the bureau tariffs. Exceptions were SWL, which publishes rates at weight minima of 50,000 and 75,000 pounds, and Texas Lines (Texas intrastate), which has rates applicable to shipments of 40,000 and 75,000 pounds.

Comparison Between New Rubber and Secondary Rubber

Table 30 shows an unusual rate structure for natural and synthetic rubber. In two rate territories, SWL and TCFB, the carriers are actually reducing their rates by more than the calculated savings. While these territories thus have structures very favorable to shippers of new rubber, TLCTR tariffs indicate the opposite. In the case shown in Table 30 , the rate reduction is only 5.2 percent, while the cost reduction is 30.7 percent.

The rate structures for reclaimed rubber do appear to be designed to encourage heavier lading. In the TLCTR rate shown, the ratio of cost to rate reduction is 2.7, and in the TCFB case, the ratios are 1.5, 1.9, and 1.9 respectively for successive increases in weight.

Data on scrap rubber are too fragmentary to permit statement of any findings. However, indications are that little incentive ratemaking has been applied to this secondary commodity; possibly, this is because there is relatively little recurring traffic, and the commodity's density is such that heavy ladings are not feasible.

Table 30

SELECTED RATE-COST RELATIONSHIPS FOR LADING ABOVE CARLOAD MINIMA

Virgin Commodity: Natural & Synthetic Rubber

Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	Rate Bureau		
	T.L.C.T.R.		
133.3	5.2	30.7	5.9
	S.W.L.		
25.0	9.2	15.0	1.6
75.0	32.2	31.3	0.97
	T.C.F.B.		
33.3	24.5	18.8	0.77
66.6	38.6	30.1	0.78
133.3	47.5	42.9	0.90

Secondary Commodity: Reclaimed Rubber

Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	Rate Bureau		
	T.L.C.T.R.		
100.0	15.1	41.0	2.7
	T.C.F.B.		
50.0	21.0	30.8	1.5
100.0	23.0	44.0	1.9
150.0	27.6	52.0	1.9

Secondary Commodity: Scrap Rubber

Lading % above minimum	Rate Reduction % of min.	Cost Reduction % of min.	Ratio Cost Reduc./ Rate Reduc.
	S.W.L.		
48.0	9.7	26.7	2.8

Source: Official Tariffs on file with I.C.C. applicable to selected study moves; and study cost calculations.

Note: For description of rate bureau abbreviations, see glossary at end of this chapter.

GLOSSARY OF RATE BUREAU ABBREVIATIONS

I.F.A.	Illinois Freight Association
N.P.C.F.B.	North Pacific Coast Freight Bureau
P.S.F.B.	Pacific Southcoast Freight Bureau
S.F.T.B.	Southern Freight Tariff Bureau
S.W.L.	Southwestern Lines
T.L.C.T.R.	Trunk Line-Central Territory Railroads Tariff Bureau
W.T.L.	Western Trunk Line Tariff Bureau

VI. TRANSPORTATION CHARGES AND COMMODITY PRICES

Introduction

The previous sections of this report have been devoted to the analysis of transportation rates and costs. Now a broader question must be addressed, namely, what do these transportation charges mean in terms of effect on delivered product costs and as compared with the product value at its average origin point. In order to answer these questions, analyses were performed to determine the following:

a. Transportation price for equal units of competing commodities.

b. Transportation price for equivalent units of competing commodities.

c. Delivered cost of equivalent amounts of competing commodities, and the transportation share of those delivered costs.

d. Transportation prices paid by receivers in various areas of the country relative to the national average, and how these transportation prices relate to regional output of the respective industries.

Methodology

Preliminary to making these analyses, technological equivalency formulas were derived (or found in published sources); data were obtained on values of the commodities, including values of non-study commodities included in the equivalency formulas; and average transportation rates were computed for each of the commodities.

The methodology for computing equivalent units of competing commodities is explained in Chapter III and the formulas used are shown in Appendix E.

Whenever possible, mid-1969 prices were used for commodity values. In a few cases, more recent prices had to be used due to a lack of historical data. Where "f.o.b. shipping point" prices were used, mean rail transportation charges were added to them to obtain delivered costs of the commodities. All prices used in this study are shown in Appendix F.

Mean transportation prices for the study commodities were computed by adding the rates per ton for the respective study moves and dividing by the number of moves. These simple averages thus reflect the range of the moves as well as territorial pricing differences. High and low prices were obtained by averaging the two highest and two lowest rates for the study moves of each commodity.

Transportation prices for non-study movements were taken from TD-1 wherever possible; the mean price selected was the "average revenue per 100 pounds" for the U.S. to U.S. summary, and the high and low prices were the average of the two highest and two lowest territorial figures in the "average revenue per 100 pounds" column. Where TD-1 data were not sufficient, i.e., where the STCC aggregation was undesirably large, data were obtained from other sources, such as trade associations and the Bureau of Mines.

The transportation charges used in the analyses herein are contained in Appendices G and H. The latter appendix shows how transportation rates for virgin materials were adjusted by equivalency factors for the effects analyses.

Findings

Transportation Charges and Delivered Prices

Table 31 shows average transportation charges for the equivalent units of virgin and secondary commodities, and the share of those charges in the estimated total delivered costs. Table 32 shows the same tabular data on a ton-for-ton basis. The data indicate that railroads' freight charges are an

Table 31

Mean Delivered Costs and Transportation Charges for Equivalent Units of Virgin and Secondary Commodities*

	Secondary Commodity			Virgin Commodity		
Industry	Mean Delivered Cost	Mean Transp. Price	Trprt.Price as % of Delivered Costs	Mean Delivered Cost	Mean Transp. Price	Trprt.Price as % of Delivered Costs
Iron and Steel[1]	$ 25.12	$ 7.71	30.7	$ 25.97	$ 5.76	22.2
Paper	19.17	7.06	36.8	112.64	7.56	6.7
Glass	20.00	8.83	44.2	17.48	7.22	41.3
Aluminum	285.80	16.17	5.7	496.80	16.99	3.4
Rubber[2]	224.00	14.90	6.7	339.89	15.67	4.6

*Equivalent units reflect one ton of the secondary commodity and
2.097 tons of iron ore, limestone and coal
.880 ton of woodpulp
1.000 ton of glass sand, soda ash, limestone and feldspar
.920 ton of primary aluminum ingot
1.000 ton of natural or synthetic rubber, carbon black, sulphur, zinc oxide, and other miscellaneous materials.

[1] Ex-Great Lakes ore is the primary virgin commodity; all line-haul transportation costs from mine to plant are included in delivered cost figure; only the rail cost from lake port to plant is reflected in the mean transportation price.

[2] Reclaimed rubber is the secondary commodity.

Sources: Commodity price data, Appendix F. Transportation price data, Appendix G. Prices adjusted by equivalency factors in Appendix E.

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insignificant part of the delivered costs for both the virgin and secondary commodities in the aluminum and rubber industries. Transportation, therefore, probably does not play an important role in the decision process for choosing between virgin and secondary materials in those industries.

In the paper industry, freight charges are a major part of the delivered costs of waste paper, though not of pulp. Thus, in paper, glass, and iron and steel industries, transportation costs are likely to have some influence on the selection process of virgin versus secondary materials. The relative rate levels in these industries must therefore be examined.

The transport charges for equivalent amounts of virgin and secondary commodities, as shown in Tables 31 through 34, indicate that the secondary commodity has a slight transportation advantage in the paper industry but not in glass or iron and steel.

Table 33 shows f.o.b. prices as well as mean transportation charges for equivalent units, and Table 34 displays the same data for equal units of the virgin and secondary materials. While for none of the study commodities average transportation charges amount to as much as or more than the f.o.b. value of the commodity--not an unusual situation when low valued materials are transported over great distances-- data in these tables illustrate that for some of the secondary commodities the mean transportation charges amount to 44 percent (I&S Scrap), 58 percent (Waste Paper), and 79 percent (Cullet) respectively of the secondary products' values prior to transportation.1/ Only glass sand, a very low valued product, has a similar relationship.

1/ If these calculations were made using the average transportation charges shown in TD-1, a weighted average rather than a mean value, the percentages would be 11.3 for iron ore and 25.8 for ferrous scrap, 10.8 for woodpulp, and 59.9 for waste paper; no data are available in TD-1 for the other pairs.

Table 32

Mean Delivered Costs and Transportation Charges Per Ton of Virgin and Secondary Commodities

	Secondary Commodity			Virgin Commodity		
Industry	Mean Delivered Cost	Mean Transp. Price	Trprt. Price as % of Delivered Costs	Mean Delivered Cost	Mean Transp. Price	Trprt. Price as % of Delivered Costs
Iron and Steel [1]	$ 25.12	$ 7.71	30.7	$ 13.94	$ 2.39	17.1
Paper	19.17	7.06	36.8	128.00	8.59	6.7
Glass	20.00	8.83	44.2	10.86	6.86	63.2
Aluminum	285.80	16.17	5.7	540.00	18.47	3.4
Rubber[2]	224.00	14.90	6.7	554.83	18.83	3.4

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[1] Ex-Great Lakes ore is the primary virgin commodity; all line-haul transportation costs from mine to plant are included in delivered cost figure; only the rail cost from lower lake port to plant is reflected in the mean transportation price.

[2] Reclaimed rubber is the secondary commodity.

Table 33

Comparison of Equivalent Units of Virgin and Secondary Materials Average f.o.b. 1969 Prices and Transportation Charges[1]

	Secondary Commodity			Virgin Commodity		
Industry	Value f.o.b.	Transp. Charges	Ratio Trprt.Price/ Value f.o.b.	Value f.o.b.	Transp. Charges	Ratio Trprt.Price/ Value f.o.b.
Iron and Steel	$ 17.41	$ 7.71	44.3	$ 20.21	$ 5.76	28.5
Paper	12.11	7.06	58.2	105.08	7.56	7.1
Glass	11.17	8.83	79.0	10.26	7.22	70.3
Aluminum	269.63	16.17	5.9	479.81	16.99	3.5
Rubber[2]	209.10	14.90	7.1	324.22	15.67	4.8

[1] Transportation charges reflect the average rates for mean distance of movement for all study commodities and average revenue per ton as shown in TD-1 for all other commodities; iron ore figures apply to Mesabi Range ore and ex-Great Lakes movements. Prices for aluminum scrap are 1971 average, and soda ash, rubber commodities are 1972 average prices.

[2] Secondary commodity is reclaimed rubber.

Sources: Commodity price data, Appendix F. Transportation price data, Appendix G. Prices adjusted by equivalency factors in Appendix E.

Table 34

Average f.o.b. 1969 Prices and Transportation Charges Per Ton of Virgin and Secondary Materials

Industry	Secondary Commodity Value f.o.b.	Mean Transp. Charges	Ratio Trprt. Price/ Value f.o.b.	Virgin Commodity Value f.o.b.	Mean Transp. Charges	Ratio Trprt. Price/ Value f.o.b.
Iron and Steel 1/	$ 17.41	$ 7.71	44.3	$ 11.55	$ 2.39	20.7
Paper	12.11	7.06	58.2	119.41	8.59	7.2
Glass	11.17	8.83	79.0	4.00	6.86	171.5
Aluminum	269.63	16.17	5.9	521.53	18.47	3.5
Rubber 2/	209.10	14.90	7.1	536.00	18.83	3.5

1/ Ex-Great Lakes ore is virgin commodity. Value shown is f.o.b. lower lake port, at rail of vessel, and thus includes transportation charges to that point.

2/ Reclaimed rubber is the secondary commodity.

Table 35 shows the range of delivered costs and transportation charges for the equivalent quantities of competing commodities. As noted before, this study has not been concerned with the numerous factors which influence purchase decisions for virgin as contrasted with secondary materials. It is realized that delivered costs for equivalent quantities of the competing materials are but one of the important considerations. If indeed all other things were equal, (which is not the case), glass container manufacturers, on average, would have to prefer using virgin materials, while all other study industries would have to prefer their secondary commodities.

The greatest advantage would accrue to paperboard manufacturers; on average, for each ton of paper stock a delivered price advantage of $93.47 was shown, regardless of the fact that for this secondary commodity the share of transportation in the delivered price is 37 percent and for short haul truck movements it is even more.

The relatively favorable situation for four of the secondary commodities, compared with their virgin counterparts, tends to suggest that any inequities in the transportation charges identified before may not be significant to the economic viability of these products. Such a conclusion would be erroneous. First, individual consumers are affected in different ways, often in opposite directions for virgin versus secondary commodities, i.e., a particular location could have a high delivered cost for a virgin commodity and the opposite for a secondary material; averages provide a useful overview, but, as noted previously, fail to deal with specific situations.

Table 35

Range of Delivered Prices and Transportation Share, Equivalent Units of Virgin and Secondary Commodities

Commodity[1]	LOWEST Delivered Price	 Transp. Price	 Trprt. as % of Delvd. Price	HIGHEST Delivered Price	 Transp. Price	 Trprt. as % of Delvd. Price
Iron Ore, Ex Great Lakes	$ 24.61	$ 4.40	17.9	$ 26.64	$ 6.43	24.1
Iron Ore, Domestic All-Rail	24.45	4.24	17.3	28.30	8.09	28.6
Iron Ore, Tidewater Origins	24.52	4.49	18.3	28.32	8.11	28.6
Iron and Steel Scrap	25.12	3.89	15.5	25.12	16.45	65.5
Woodpulp	112.64	2.06	1.8	112.64	18.83	16.7
Waste Paper	19.17	5.20	27.1	19.17	17.60	91.8
Glass Sand	14.18	3.92	27.6	22.08	11.82	53.5
Cullet	20.00	3.06	15.3	20.00	16.84	84.2
Primary Alum. Ingot	496.80	2.20	0.4	496.80	28.52	5.7
Alum. Scrap	285.80	5.60	2.0	285.80	50.40	17.6
Nat.&Syn. Rubber	331.69	7.03	2.1	359.92	35.69	9.9
Reclaimed Rubber	224.00	10.09	4.5	224.00	22.45	10.0

[1] Virgin commodities are adjusted to equivalent units, as per formulas in Appendix E.

Sources: Commodity price data, Appendix F. Transportation price data, Appendix G. Prices adjusted by equivalency factors in Appendix E.

Second, if indeed shippers of a secondary commodity are required to pay higher freight rates than appear to be justified, a reduction in such rates may have the effect of balancing what might otherwise be an uneconomical total production cost. So while the relatively favorable posture for four secondary commodities was shown in the average figures computed, this is not to suggest that the transportation charges applicable cannot or do not inhibit greater utilization of these commodities. These thoughts are reinforced by the locational analysis following.

Geographic Analyses

Table 36 provides a ready comparison between the installed capacity or value of shipments in each of the five geographic regions and the relative average transportation price paid by shippers of the study commodities in 1969. It is a fair assumption to make that geographic industry concentrations will normally be related to their sources of materials and/or markets for their products. Hence, if an industry has mainly located in proximity to its raw material supplies, it would follow that it pays on average the lowest transportation price for its raw material shipments compared with those members of the same industry located farther away from their sources of supply.

The data in Table 36 show a remarkable absence of consistency in terms of the above theory, indicating that in most cases the study industries have not based locational decisions on their relative transportation costs for the study virgin commodities. For example, almost 84 percent of the integrated steel making capacity is located in Territory One; its average transportation costs for iron ore are somewhat

Table 36

Geographic Distribution of Study Industries and Relative Rail Transportation Charges by Rate Territory for Study Commodities

Industry/Commodity	Region/Territory 1	2	3	4	5
Integrated Steel[1]	83.7	5.7	1.4	2.7	6.5
iron ore[2]	102.2	104.8	97.3	151.7	112.8
I&S Scrap—/	94.6	110.5	114.5	149.7	97.1
Paperboard[1]	31.2	33.6	4.0	16.8	14.4
woodpulp[2]	117.0	73.7	113.1	55.3	112.4
waste paper[2]	100.7	81.4	121.7	99.3	109.1
Glass container[1]	69.5	16.1	--	6.9	7.5
glass sand[2]	103.6	80.0	50.0	89.7	138.8
cullet[2]	83.9	159.4	--	204.4	57.7
Aluminum [1]	24.3	21.6	1.5	22.0	30.6
al. ingot[2]	116.5	84.9	114.6	94.1	66.2
al. scrap[2]	96.7	124.2	112.9	87.9	81.0
Rubber Reclaimed[1]	71.0	29.0	--	--	--
Synth. rubber[2]	132.2	74.3	108.1	48.3	239.3
Recl. Rubber[2]	68.3	101.1	126.7	126.8	214.3

[1] % of installed capacity or value of shipments

[2] average transportation rate per ton for each territory as a percent of the national average rate per ton.

Source: Industry data calculated from 1967 Census of Manufactures and industry furnished data. Transportation data calculated from 1969 One Percent Waybill Sample; figures reflect territorial average rate per ton divided by national average rate per ton; both rates are weighted averages, e.g., total revenue for territory divided by total tonnage for territory, etc.

higher than the national average. Steel scrap shipped to the predominant territory enjoyed a five percent advantage, on average, compared with the national average rate per ton of scrap.

A similar situation was found to exist in the glass container industry where almost 70 percent of capacity is also in Territory One, incurs an above national average transportation cost for glass sand but the average rate per ton of cullet is 16 percent less than the national average.

For the secondary aluminum industry the situation is reversed. Territory Five has the largest share of capacity and lowest average rate per ton for aluminum ingot and aluminum scrap.

Reclaimed rubber rates in Territory One are substantially below the national average, while the average rate for synthetic rubber is appreciably above the average, though this territory contains over 71 percent of this industry's capacity.

In summary, the average destination territory transportation prices per ton of secondary materials were found to be lower than the national average for the same commodity in all territories with the largest share of installed capacity; a contrary finding was made for three of the virgin materials.

VII. RAIL RATE MAKING PRINCIPLES

Introduction

Numerous factors enter the ratemaking process. Costs are but one element, although they are basic in the sense that rates should not go below the costs incurred in handling the traffic. But once rates exceed the floor established by costs, the question of what constitutes the ceiling is exceedingly complex.

Transport pricing is more complex than pricing in other industries, not only because of government regulation, but also because common carriers must hold themselves out to move every product required by the national economy--and always at a predetermined, published price (or freight rate). Electronic calculators and coal may move in the same train.

To handle the pricing of this vast product mix, the railroads (and then other carriers) developed the concept of a freight classification system. Every commodity is assigned a rating in relation to "first class" or class 100". This rating is intended to reflect the judgment of experienced traffic officers as to the relative transportation characteristics of each commodity offered up for movement. Knowing the rating, one can go to a first class rate scale and calculate the rate for each movement. For example, if the first class rate is $10.00 per ton for a haul of 300 miles and if an item is rated at 60% of first class, the shipper knows that his rate will be $6.00.

Over the years, some fifteen elements have evolved as determinants of the classification rating, as follows:

1. Shipping weight per cubic foot.
2. Liability to damage.
3. Liability to damage other commodities with which it is transported.
4. Perishability.
5. Liability to spontaneous combustion or explosion.
6. Susceptibility to theft.
7. Value per pound in comparison with other articles.
8. Ease or difficulty in loading or unloading.
9. Stowability.
10. Excessive weight.
11. Excessive length.
12. Care or attention necessary in loading and transporting.
13. Trade conditions.
14. Value of service.
15. Competition with other commodities transported.

No formula is available for weighting each of these elements. The composite rating is a matter of judgment by experienced officers looking at each commodity in relation to other commodities already rated.

It was not long, however, before it was recognized that individual movements of specific commodities might have special characteristics which would justify a departure from a general class rate scale and a general classification rating. Today, by far the vast bulk of the traffic actually moves under specific commodity rates, usually well below the applicable class rates. When a new movement arises, the railroads will automatically apply the class rates unless the shipper requests and then negotiates a new commodity or exception rate. In establishing commodity rates, carriers take in consideration a number of additional factors. Most prominent among these are:

1. volume of movement
2. regularity and duration of movement
3. direction and length of movement
4. intermodal competition

The commodities under study here all move on commodity rates. The present levels of these rates are usually the result of negotiations between shippers and carriers, occasionally influenced by I.C.C. decisions as a result of complaints filed by interested parties. Each group of rates is arrived at by weighing all of the factors in each case, but it can be said that the amount of contribution above variable cost is arrived at with special regard to the "value of service" and "competition".

Analysis of the ratemaking factors described above well demonstrate that many of them can be ultimately expressed in cost terms. Elements like "value of service" or "competition with other commodities" or "intermodal competition" are all translatable into one concept: elasticity of demand. In short, the ratemaker finally must look at the variable cost of providing the service, and the effect of various possible rates on the movement of the traffic. From a private enterprise point of view, the ratemaker seeks to maximize the net contribution from each type of traffic subject to a number of legal restrictions. For example, overall earnings cannot be in excess of a reasonable return. Again, individual rates may not result in unjust discrimination against other persons or places. Such restrictions add complexity to the evaluation of individual rates, but the practice is for shippers to match each other's rates jealously and this practice helps to minimize the number of rate cases actually filed.

It is beyond the scope of this report to undertake a full investigation of how discrimination cases have been handled by the I.C.C. However, we can approximate the extent to which non-cost factors affect the rate levels on different movements. This will show that rate differences which are not related to costs are not necessarily sufficient grounds for proving that a given rate is unduly discriminatory.

The 1969 Burden Study published by the Department of Transportation gives a general guide to these variations. In that study, broad average costs are applied to aggregate territorial flows of traffic. The ratio of revenue to variable costs for all traffic combined was 127.6; thus, the non-cost factors for the aggregate traffic of the railroads produced 27.67 more revenue than would have been received if the rates were based solely on variable costs. One does not have to accept the method of calculating costs or to accept the rate levels to accept this ratio as a base line to compare the results for various commodities calculated on a uniform basis.

Relative to this overall average, the study shows a vast range of results. Some commodities were moving at rate levels well below the calculated variable costs, while some others were moving at rates which were 3.6 times the calculated costs. This means that non-cost factors can play a major part in the determination of rates. Thus, mere differences in the ratio of revenue to cost is not enough to support a claim of unreasonable rates.

As mentioned above, the study commodities show varying ratios of revenues to costs. Among the cost factors to be considered are regularity and size of movement, and as to these factors, the virgin materials would seem to have a cost advantage. Among non-cost factors, the matter of intermodal competition often plays an important part. On this issue, the secondary materials generally, especially on longer hauls, are not attractive to the motor or water carriers; if they were, railroad rates in the normal course of competition might be set at lower levels in the competitive areas.

Reasonableness of Rates

Under Section 1 of the Interstate Commerce Act, railroads are required to charge just and reasonable rates. The I.C.C. is empowered to decide whether a specific rate meets that criterion. Over the years, in a variety of cases, the Commission has developed guidelines focusing on four issues:

a. Compensativeness: this is the "rate floor" discussed in detail in Chapter III.

b. Comparative Standards: this embodies all of the commodity transportation characteristics discussed in this Chapter.

c. Demand: this is the "value of service" concept; put simply, it says rates may not be designed to discourage traffic; they cannot exceed what the traffic will bear.

d. Public Policy: this caveat permits the setting of rates for public interest reasons at levels designed to encourage or discourage traffic to bring about some desired social or economic result.

Rate Discrimination

Section 3 of the Act, while not referring to "discrimination," makes it unlawful for a railroad to give "any undue or unreasonable preference or advantage to any particular person, company, firm, corporation, association, locality, port, port district, gateway, transit point, region, district, territory, or any particular description of traffic," or to subject any of the above to any "undue or unreasonable prejudice or disadvantage."

Rate controversies under Section 3 relate to rate relationships, and not to the reasonableness of the rates themselves. Rates may be reasonable under Section 1, but unduly preferential or prejudicial under Section 3.

Whether a rate or set of rates is unlawfully discriminatory is a question of fact for the ICC to decide. It should be emphasized that evidence of a mere rate disparity is not sufficient to make a showing of unlawfulness; rather, the disparity must be shown to be excessive and preferential to one person, place or commodity.

Table 37, containing a summary of the average transport characteristics, revenues and contribution for the study moves, is presented here to demonstrate the wide variations in rates sanctioned by the ICC. The existence of these wide differences does not prove *a priori* that they are unduly divergent.

In order to demonstrate commodity rate discrimination, i.e., that rates discriminate against one commodity in favor of another, it must be shown that the two commodities are quite similar and that they actually compete in the market place. Again, it is the prerogative of the ICC to decide, based on the facts in each case, whether a competitive relationship exists between two or more commodities.

It has been held that competition must be real and substantial; competing commodities must have the same use and must be substitutable, one for the other. Finally, for a finding of undue rate prejudice to be made, there must be proof that the rate relationship has been the source of actual injury to the complaining party in marketing his product.

Exceptions justifying rate differences between competing commodities have been approved by the Commission when one or more of the following apply: (a) differences in cost of services, (b) value differences (remembering that a commodity's value is considered to be a transportation characteristic for ratemaking purposes), and (c) intermodal competition (which may be significant for one commodity, but not for its competing material).

TABLE 37

Average Transportation Characteristics, Rates and Contribution Rates for Study Moves

	Avg. load per car - tons	Avg. Length of Haul mi.	Avg. Rev. Per Car $	Avg. Rate Per Ton $	Contrib.As % of Revenue
Iron Ore	81.2	206	211	2.60	41.5
Iron & Steel Scrap	55.5	328	398	7.17	48.8
Woodpulp	59.4	582	535	9.00	46.5
Waste Paper	37.0	374	275	7.43	30.5
Glass Sand	66.4	625	465	7.00	23.0
Cullet	64.2	450	550	8.57	51.3
Primary Alum. Ingot	58.7	1,275	1,004	17.10	54.7
Alum. Scrap	44.3	591	443	14.04	37.5
Nat. & Syn. Rubber	49.0	962	845	17.23	52.5
Scrap Rubber	28.6	435	310	10.85	39.8
Reclaimed Rubber	51.4	606	730	14.20	66.2

Source: Master Tables, Appendix A

VIII. CONCLUSIONS

Findings--Competing Commodities

Both revenues per car and ton in relation to cost of service showed great variation within and between study commodities. On average, rates for virgin and secondary commodities were found to be in the zone of reasonableness, but there are numerous individual situations with such large differences that some inequities surely exist.

Three of the secondary commodities were found, on average, to make substantially higher contributions than their virgin counterparts. For two of these three (iron and steel scrap and cullet), the progression of rail rates over increased distances tends to discourage longer hauls; for these commodities, the decline in revenue per ton-mile or car-mile over distance is significantly less than for iron ore and glass sand. While the third commodity with a very high contribution rate, reclaimed rubber, shows a sharp decline in the contribution rate over distance, the small sample of scrap rubber portrays a reverse situation: its contribution rate rises sharply with distance.

If the I.C.C. should find that indeed the pairs of virgin and secondary commodities constitute genuine and substantial competitors, the specific differences found in common moves would raise serious questions of inequities. However, even for the much discussed pair of iron ore and steel scrap, no clear determination has been made by the I.C.C. Whereas in Ex Parte Nos. 256 and 259, the Commission held that these two commodities compete,[1] it expounded a contradictory viewpoint in subsequent proceedings. In Ex

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[1] see 332 I.C.C. 280, at p. 331; 332 I.C.C. 714, at p. 743.

Parte 281, "...ferrous scrap and iron ore do not specifically and directly compete to the extent that they require similar rate treatment" (see 341 I.C.C. 287, at p. 411).

The secondary materials industries covered in this study contend that their commodities compete with their virgin counterparts. As noted previously, the ICC must make a formal determination that such competition does in fact exist between two commodities before a case of discrimination can be made. On this point, the Commission has been quite ambivalent with regard to ore and ferrous scrap, and silent with regard to the other commodities studies herein. Whereas the broad guidelines established in case law over the decades of regulation may not be met in all situations or in all territories, the large differences pointed out before suggest that in numerous situations the effect of higher rates for ferrous scrap, cullet, and reclaimed rubber, in particular, may inhibit their increased utilization.

Since rates for these commodities stay relatively high as distance increases, this may have an effect upon the expansion of the market for them. This conclusion, however, is limited by the fact that the effect of freight rates on delivered prices of the secondary materials is relatively small for two of the secondary commodities--scrap rubber and aluminum scrap.

Incentive Rates

Another more general conclusion deals with the incentive rate structure for secondary commodities. The problem here is cause and effect. It might be argued that the railroads have not encouraged more incentive loading and multiple car shipments for the secondary commodities because the density of these commodities and their frequency of shipments do not lend themselves to the effective utilization of these rates. However, it is also possible that the absence of these rates discourages shippers from making the necessary investments in machinery to obtain the requisite compactness for heavy loads and to organize their markets so that multiple car shipments could be made. Our research indicates that both of the hypotheses apply. Shippers of steel scrap have reported that carriers have increasingly acceded to granting lower multiple car rates, but that their use has been inhibited by shortages of car supply and insufficient rate reductions. With the rate structure generally limited to incentives at the 50 ton per car level and an average lading of over 55 tons per car observed in the study moves (with some cars loaded above 70 tons), it is evident that shippers and carriers might benefit from new incentives at a reduced rate per ton.

For cullet, it will be remembered, the rate structure is mostly limited at 50 tons per car. Though shippers generally have not benefited from heavier lading in terms of a lower rate per ton we have shown a fair proportion of the study moves loaded at over 60 tons per car.

What is missing for both of these commodities is an incentive rate structure which provides for substantially reduced rates for ladings above the specified minima. Regardless of the existing rate levels at the specified minima, carriers by rail stand to gain and shippers would be seriously encouraged to effectuate heavier ladings by relatively low rates for that portion of a carload that exceeds the minimum weight. This principle is reflected in some rates for reclaimed rubber, as well as numerous other commodities. Its absence for ferrous scrap and cullet can be seriously inhibiting in the increased movement and utilization of these secondary materials.

Contract Carriage

As directed, our efforts were concentrated on movements by rail. This focus was well-justified by the railroads' predominant role in the transportation of the study commodities. However, we should also mention the services provided primarily by contract carriers hauling paper stock and manufactured paper products. While, on average, these carriers operate at variable cost deficits in the transport of waste paper, though their rates are somewhat higher than rail rates, their aggregate revenues from inbound and outbound movements combined are reported to result in reasonable returns on these carriers' investments. Railroads usually cannot handle these waste paper movements, because collection and processing plants have no railroad facilities; hence, these contract carriers render an essential service in the public interest at a relatively low price.

Practically all of the study industries, except the integrated steel industry, make use of contract and private carriage in the transport of secondary commodities. Shippers' private equipment, principally employed in the transport of manufactured products, is utilized also for the movement of secondary materials and other consumables to balance the traffic, thereby spreading both fixed and variable costs to increased tonnage.

This economic principle embodied in contract and private motor carrier operations is not limited to these modes. Railroads have applied it also; the movement of coal to ports and iron ore on the backhaul is an apparent example. However, no evidence has been uncovered in this study to suggest that railroads have, in fact, employed ratemaking principles relying on reciprocal moves for any of the secondary commodities. This concept, as noted above, so basic to contract motor carriage, has not been permitted specifically in railroading; though tacit agreements for rates tying together inbound and outbound movements of virgin and manufactured commodities are in use. Whether such round-trip ratemaking could be effectively employed by railroads and shippers of secondary materials could be a worthwhile subject for further study.

General

Finally, it seems important to reiterate a conclusion suggested at various points in this report. Neither railroads nor motor carriers have a master plan for ratemaking. There is no single national formula for all rates and such a formula is probably undesirable and likely to lead to too much rigidity. Moreover, carriers normally do not consider in their ratemaking processes the relative rate levels for virgin and secondary commodities. Each is an entity in itself and is considered in light of the many cost-related and other variables applicable to the transport characteristics of each. No other approach to ratemaking has been ordered by the Federal regulators. Conceivably, such action is wanting. The recent I.C.C. studies on environmental impacts have tended to deal with broad averages, typically weighted by the aggregate traffic pattern for the entire nation or an entire rate region, with the result that individual inequities are obscured.

Enlightened public policy development and enforcement in this area requires the examination and removal of inequities at the detailed, individual movement level.

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APPENDIX A

MASTER TABLES
Common and Supplemental Study Moves

Contents

Iron Ore, Iron and Steel Scrap	4 pages
Woodpulp, Waste Paper	6 pages
Glass Sand, Cullet	3 pages
Aluminum Ingots, Aluminum Scrap	4 pages
Natural & Synthetic Rubber, Reclaimed Rubber	4 pages

APPENDIX A

MASTER TABLES OF COMMON AND SUPPLEMENTAL MOVES OF VIRGIN (V) AND SECONDARY (S) COMMODITIES SELECTED FOR STUDY

STCC NO.	VIRGIN COMMODITIES	NO. OF MOVES		STCC NO.	SECONDARY COMMODITIES	NO. OF MOVES
101	IRON ORE	26	--	40211	IRON AND STEEL SCRAP	30
1441320	GLASS SAND	21	--	3229924	CULLET	17
26111	WOODPULP	18	--	40241	WASTE PAPER	42
33341	PRIMARY ALUMINUM INGOT	27	--	4021430	ALUMINUM SCRAP	24
0842325 2821220	NATURAL RUBBER SYNTHETIC RUBBER	29	--	3031190 4026160	RECLAIMED RUBBER SCRAP RUBBER	10 7

NOTE: Cost, revenue, and contribution per car figures have been rounded to the nearest dollar.

SOURCES: Carload Waybill Statistics, One Percent Waybill Terminations, 1969, Interstate Commerce Commission; Tariffs on file with the Interstate Commerce Commission; Industry furnished data (supplemental moves, rate and revenue verifications); Rail Carload Cost Scales by Territories for the year 1969, statement 1C1-69, issued but not adopted by the Interstate Commerce Commission (cost scales for iron ore adjusted to reflect special studies of the ICC and selected railroads).

APPENDIX A

Virgin Commodity (V): Iron Ore

Secondary Commodity (S): Iron and Steel Scrap

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V S	Origin - Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI		
										Per Car $	Per Ton $	% of Revenue
V	Phila.,Pa.-Bethlehem,Pa.	61	O.Hopper	83	70.00	.84	1.96	162.00	2.33	92.00	1.11	57
S	Swedeland,Pa.-Hamburg,Pa.	59	Gondola	62	115.00	1.85	4.08	250.00	2.21	135.00	2.18	54
	Ratio, S to V			.75	1.64	2.20	2.08	1.54	.95	1.47	1.96	.95
V	Phila.,Pa.-Swedeland,Pa.	63	O.Hopper	69	69.00	1.00	1.65	114.00	1.65	45.00	.65	39
S	Reading,Pa.-Chester,Pa.	68	Gondola	49	116.00	2.37	3.80	187.00	1.60	71.00	1.45	38
	Ratio, S to V			.71	1.68	2.37	2.30	1.64	.97	1.58	2.23	.97
V	Bucks Co.,Pa.-Saxonburg,Pa.	385	O.Hopper	79	197.00	2.50	3.62	286.00	1.45	89.00	1.13	31
S	Indian.,Ind.-Farrell,Pa.	351	Gondola	72	237.00	3.29	8.19	590.00	2.49	353.00	4.90	60
	Ratio, S to V			.91	1.20	1.32	2.26	2.05	1.72	3.97	4.34	1.94
V	Phila.,Pa.-Saxonburg,Pa.	364	O.Hopper	81	190.00	2.35	3.62	294.00	1.54	104.00	1.28	35
S	Sharonville,O.-Bulter,Pa.	341	Gondola	46	212.00	4.61	6.66	306.00	1.44	94.00	2.04	31
	Ratio, S to V			.57	1.12	1.96	1.84	1.04	.94	.90	1.59	.89
V	Phila.,Pa.-Saxonburg,Pa.	364	O.Hopper	84	190.00	2.27	3.62	305.00	1.59	115.00	1.37	38
S	Marion,Ind.-Butler,Pa.	347	Gondola	56	223.00	3.98	6.88	385.00	1.73	162.00	2.89	42
	Ratio, S to V			.67	1.17	1.75	1.90	1.26	1.09	1.41	2.11	1.11
V	Conneaut,O.-Saxonburg,Pa.	125	O.Hopper	86	96.00	1.12	2.42	208.00	2.16	112.00	1.30	54
S	Columbus,O.-Canton,O.	129	Gondola	65	143.00	2.20	5.65	369.00	2.57	226.00	3.48	61
	Ratio, S to V			.76	1.49	1.96	2.33	1.77	1.19	2.02	2.68	1.13
V	Ashtabula Co.,O.-Aliquippa, Pa.	156	O.Hopper	68	104.00	1.53	2.10	143.00	1.37	39.00	.57	27
S	Syracuse,N.Y.-Harriet,N.Y.	158	Gondola	52	150.00	2.88	5.33	277.00	1.85	127.00	2.44	46
	Ratio, S to V			.76	1.44	1.88	2.54	1.94	1.23	3.26	4.28	1.70
V	Ashtabula Co.,O-Aliquippa, Pa.	156	O.Hopper	80	104.00	1.30	2.10	167.00	1.62	63.00	.79	38
S	Newark,N.J.-Steelton,Pa.	170	Gondola	67	160.00	2.39	6.14	414.00	2.57	254.00	3.79	61
	Ratio, S to V			.84	1.54	1.84	2.92	2.48	1.59	4.03	4.80	1.61

Virgin Commodity (V): Iron Ore

Secondary Commodity (S): Iron and Steel Scrap

V S	Origin - Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI		
										Per Car $	Per Ton $	% of Revenue
V	Ashtabula Co.,O.-Aliquippa, Pa.	156	O.Hopper	79	104.00	1.32	2.10	165.00	1.59	61.00	.77	37
S	Cleveland,O.,-Neville Island, Pa.	153	Gondola	26	139.00	5.35	7.38	195.00	1.38	56.00	2.15	29
	Ratio, S to V			.33	1.34	4.05	3.51	1.18	.87	.92	2.79	.78
V	Ashtabula Co.,O.-Monessen, Pa.	162	O.Hopper	67	106.00	1.58	2.54	170.00	1.61	64.00	.96	38
S	Youngstown,O.,-S.Buffalo, N.Y.	177	Gondola	72	165.00	2.29	5.67	407.00	2.47	242.00	3.36	59
	Ratio, S to V			1.07	1.56	1.45	2.23	2.39	1.53	3.78	3.50	1.55
V	Bucks Co.,Pa.-Bessemer Int., Pa.	359	O.Hopper	83	190.00	2.28	3.62	298.00	1.59	108.00	1.30	36
S	Grand Rapids, Mi.-Koppel, Pa.	374	Gondola	61	237.00	3.89	9.04	552.00	2.32	315.00	5.16	57
	Ratio, S to V			.73	1.25	1.71	2.50	1.85	1.46	2.92	3.97	1.58
V	Conneaut,O.-N.Bessemer,Pa.	142	O.Hopper	84	104.00	1.24	2.42	2.08	1.95	104.00	1.24	50
S	McGrew,Mi.-Defiance,O.	155	Gondola	88	162.00	1.84	5.45	4.80	2.96	318.00	3.61	66
	Ratio, S to V			1.05	1.55	1.48	2.25	2.31	1.52	3.06	2.91	1.32
V	Bucks Co.,Pa.-Bessemer,Pa.	359	O.Hopper	75	1841.00	2.46	3.62	272.00	1.47	87.00	1.16	32
S	Pontiac,Mi.-Latrobe,Pa.	360	Gondola	64	234.00	3.66	8.47	542.00	2.31	308.00	4.81	57
	Ratio, S to V			.85	1.27	1.49	2.34	1.99	1.57	3.54	4.15	1.78
V	Conneaut,O.-McKeesport,Pa.	149	O.Hopper	100	110.00	1.10	2.42	242.00	2.20	132.00	1.32	55
S	Cleveland,O.-Dearborn Mi.	159	Gondola	30	142.00	4.73	7.63	227.00	1.61	85.00	2.84	37
	Ratio, S to V			.30	1.29	4.30	3.15	.94	.73	.64	2.15	.67
V	Ashtabula,O.-Pittsburgh, Pa.	139	O.Hopper	84	102.00	1.21	2.42	203.00	2.00	101.00	1.20	50
S	Toledo,O.-Canton,O.	135	Gondola	48	140.00	2.96	5.93	282.00	2.00	142.00	2.96	50
	Ratio, S to V			.57	1.38	2.45	2.45	1.39	1.00	1.41	2.47	1.00

APPENDIX A

Virgin Commodity (V): Iron Ore

Secondary Commodity (S): Iron and Steel Scrap

Page 3 of 4

V S	Origin - Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Cleveland,O.-P+OV Jct., Allegheny Co.,Pa.	151	O.Hopper	83	106.00	1.28	2.59	215.00	2.02	1.09	1.31	51
S	Cleveland,O.-Neville Island,Pa.	153	Gondola	26	139.00	5.35	7.38	195.00	1.38	56.00	2.15	29
	Ratio, S to V			.31	1.31	4.18	2.85	.91	.68	.51	1.64	.57
V	Cleveland,O.-Warren,O.	53	O.Hopper	68	65.00	.96	1.86	123.00	1.94	58.00	.85	47
S	Cleveland,O.-Warren,O.	53	Gondola	45	110.00	2.44	4.34	194.00	1.78	84.00	1.87	43
	Ratio, S to V			.66	1.68	2.54	2.33	1.58	.92	1.45	2.20	.91
V	Cleveland,O.-Youngstown,O.	67	O.Hopper	78	72.00	.92	1.86	141.00	2.02	69.00	.88	49
S	Cleveland,O.-Youngstown,O.	67	Gondola	49	116.00	2.22	4.34	212.00	2.05	96.00	1.96	45
	Ratio, S to V			.63	1.62	2.41	2.33	1.50	1.01	1.39	2.23	.92
V	Glenwood,Al.-Alabama City, Al.	226	O.Hopper	54	108.00	1.99	2.57	138.00	1.29	30.00	.56	22
S	Macon,Ga.-Woodlawn,Al.	245	Gondola	62	145.00	2.34	6.02	372.00	2.57	227.00	3.66	61
	Ratio, S to V			1.15	1.35	1.18	2.34	2.70	1.99	7.57	6.54	2.77
V	Ferrum, Cal.-Kaiser,Cal.	112	O.Hopper	105	85.00	.81	1.65	173.00	2.04	88.00	.84	51
S	Fleta,Cal.-Long Beach,Cal.	117	Gondola	40	129.00	3.23	5.40	216.00	2.67	87.00	2.17	40
	Ratio, S to V			.38	1.52	3.99	3.27	1.25	1.31	.99	2.58	.78
V	Conneaut,O.-Bucks Co.,Pa.	482	O.Hopper	66	225.00	3.41	3.95	261.00	1.16	36.00	.55	14
S	Gary,Ind.-Brilliant Br.,Pa.	434	Gondola	62	261.00	4.21	6.52	404.00	1.55	179.00	2.89	44
	Ratio, S to V			.94	1.16	1.23	1.65	1.55	1.34	4.97	5.78	3.14
V	Joanna,Pa.-Wilmore,Pa.	247	O.Hopper	102	153.00	1.50	3.36	343.00	2.10	190.00	1.86	55
S	N.Flint,Mi.-Harriet,N.Y.	262	Gondola	68	198.00	2.91	7.78	530.00	2.67	332.00	4.88	63
	Ratio, S to V			.67	1.30	1.94	2.32	1.55	1.27	1.75	2.62	1.15
V	Huron Dock,O.-Steubenville, O.	156	O.Hopper	80	107.00	1.34	2.29	182.40	1.28	75.00	.95	24
S	Cincinnati,O.-Mansfield,O.	167	Gondola	67	159.00	2.37	6.69	456.00	2.82	297.00	4.44	65
	Ratio, S to V			.84	1.48	1.77	2.92	2.50	2.20	3.96	4.67	2.71

APPENDIX A

Virgin Commodity (V): Iron Ore

Secondary Commodity (S): Iron and Steel Scrap

Page 4 of 4

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Kaiser,Cal.-Long Beach, Cal.	64	O.Hopper	111	61.00	.55	1.64	182.00	2.98	121.00	1.09	66
S	Rocktram,Cal.-Oakland, Cal.	65	Gondola	74	119.00	1.61	3.98	295.00	2.47	176.00	2.38	60
	Ratio, S to V			.67	1.95	2.93	2.43	1.62	.83	1.45	2.18	.91
V	Conneaut,Oh.-N.Bessemer, Pa.	142	Hopper	91	104.00	1.15	2.42	221.00	2.10	117.00	1.29	53
S	Kalamazoo,Mich.-Saginaw Mich.	133	Gondola	58	143.00	2.47	4.89	285.00	1.99	142.00	2.45	50
	Ratio, S to V			.64	1.37	2.15	2.02	1.29	1.06	1.21	1.90	.94
V	Mountain Iron,Mn.-S.Chicago, Ill.	513	O.Hopper	73	207.00	2.84	3.86	282.00	1.36	75.00	3.86	27
S	Gary,Ind.-Bessemer,Pa.	443	Gondola	68	271.00	3.98	6.88	446.00	1.73	197.00	2.90	42
S	Silvis,Ill.-El Paso,Tex.	1252	Gondola	50	502.00	10.04	18.10	830.00	1.80	403.00	8.06	45
S	SanFrancisco,Cal.-Dalton, Utah	821	Gondola	31	327.00	10.54	14.80	379.00	1.40	132.00	4.26	29
S	SanFrancisco,Cal.-Dalton, Utah	821	Gondola	36	336.00	9.34	14.80	422.00	1.58	197.00	5.47	37
S	Pittsburg,Cal.-Dominguez, Cal.	445	Gondola	71	262.00	3.68	7.68	651.00	2.09	284.00	4.00	52
S	Markham,Ill.-El Paso,Tex.	1369	Gondola	26	449.00	17.28	22.90	775.00	1.33	146.00	5.62	25

Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

V S	Origin - Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Woodland,Me.-Bucksport, Me.	155	Box	68	179.00	2.63	2.70	184.00	1.03	5.00	.07	3
S	Willis,Mi.-Otsego,Mi.	144	Box	40	139.00	3.49	4.80	192.00	1.38	53.00	1.33	28
	Ratio, S to V			.58	.78	1.33	1.78	1.04	1.34	10.60	1.90	9.33
V	Woodland,Me.-Lincoln,Me.	118	Box	63	155.00	2.46	3.72	233.00	1.51	78.00	1.24	33
S	Johnstown,Pa.-Steubenville, Oh.	121	Box	26	125.00	4.81	5.60	144.00	1.16	19.00	.73	13
	Ratio, S to V			.41	.81	1.96	1.51	.62	.77	.24	.6	.39
V	Woodland,Me.-Brewer Jct., Me.	137	Box	65	167.00	2.56	2.75	178.00	1.07	11.00	.17	6
S	Willis,Mi.-Otsego,Mi.	144	Box	40	139.00	3.49	4.80	192.00	1.38	53.00	1.33	28
	Ratio, S to V			.62	.84	1.36	1.75	1.08	1.29	4.82	7.8	4.67
V	Woodlawn,Me.-Brewer Jct., Me.	137	Box	52	167.00	3.20	3.43	178.00	1.07	11.00	.21	6
S	Cook Co.,Ill.-Otsego,Mi.	150	Box	47	161.00	3.42	5.40	253.00	1.58	92.00	1.96	36
	Ratio, S to V			.90	.97	1.07	1.57	1.42	1.48	8.36	9.33	6.00
V	Lincoln,Me.-Brewer Jct., Me.	45	Box	53	111.00	2.10	1.33	70.00	.63	(41.00)	-	-
S	Ingham Co.,Mi.-Battle Creek, Mi.	45	Box	40	109.00	2.73	3.60	144.00	1.32	35.00	.88	24
	Ratio, S to V			.75	.98	1.30	2.71	2.06	2.10	-	-	-
V	Woodland,Me.-S.Brewer,Me.	139	Box	65	168.00	2.58	2.75	178.00	1.07	10.00	.15	6
S	Cook Co.,Ill.-Kalamazoo,Mi.	135	Box	44	139.00	3.16	5.40	238.00	1.71	99.00	2.25	42
	Ratio, S to V			.68	.83	1.22	1.96	1.34	1.60	9.90	15.00	7.00
V	Woodland,Me.-S.Brewer,Me.	139	Box	64	168.00	2.62	2.81	178.00	1.07	10.00	.16	6
S	Cook Co.,Ill.-Kalamazoo,Mi.	135	Box	33	139.00	4.21	5.40	178.00	1.28	39.00	1.02	22
	Ratio, S to V			.52	.83	1.61	1.92	1.00	1.20	3.90	6.38	3.67
V	Lincoln,Me.-S.Brewer,Me.	47	Box	42	113.00	2.69	1.65	64.00	.61	(47.00)	-	-
S	Oshkosh,Wi.-Green Bay,Wi.	45	Box	32	90.00	2.84	3.00	96.00	1.06	6.00	.19	7.00
	Ratio, S to V			.76	.80	1.06	1.82	1.50	1.74	-	-	-

APPENDIX A

Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

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V S	Origin - Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Lincoln,Me.-S.Brewer,Me.	47	Box	55	113.00	2.06	1.28	70.00	.62	(43.00)	-	-
S	Oshkosh,Wi.-Green Bay,Wi.	45	Box	33	91.00	2.76	5.00	165.00	1.81	75.00	2.27	45
	Ratio, S to V			.60	.80	1.34	3.91	2.36	2.92	-	-	-
V	Berlin ,N.H.-S.Brewer,Me.	183	Box	61	189.00	2.33	6.60	399.00	2.83	210.00	3.44	53
S	Chicago,Ill.-Neenah Menash, Wi.	167	Box	42	126.19	3.00	5.00	210.00	1.60	84.00	2.00	40
	Ratio, S to V			.69	.67	1.29	.76	.53	.57	.40	.58	.75
V	Lincoln,Me.-Waterville,Me.	99	Box	58	142.00	2.44	2.38	137.00	.98	(5.00)	-	-
S	Newark,N.Y.-N.Tonawanda,N.Y.	105	Box	40	127.00	3.19	8.00	320.00	2.51	193.00	4.83	60
	Ratio, S to V			.69	.90	1.31	3.36	2.34	2.56	-	-	-
V	Madison,Me.-Winslow,Me.	29	Box	54	104.00	1.92	1.01	55.00	.53	(49.00)	-	-
S	E.Buffalo,N.Y.-Lockport,N.Y.	27	Box	35	102.00	2.91	4.00	132.00	1.37	30.00	.86	23
	Ratio S to V			.65	.98	1.52	3.96	2.40	2.58	-	-	-
V	Madison,Me.-Winslow,Me	29	Box	50	104.00	2.07	1.10	55.00	.53	(49.00)	-	-
S	McKees Rocks,Pa.-Oakmont,Pa.	27	Box	28	100.00	3.56	4.00	110.00	1.12	10.00	9.00	.36
	Ratio,S to V			.56	.96	1.72	3.64	2.00	2.11	-	-	-
V	Madison,Me.-Winslow,Me.	29	Box	45	104.00	2.30	1.22	55.00	.31	(48.00)	-	-
S	Zanesville,Oh.-Coshocton,Oh.	30	Box	25	100.00	3.98	4.00	100.00	1.01	-	-	-
	Ratio S to V			.56	.96	1.73	3.28	1.82	3.26	-	-	-
V	Madison,Me.-Livermore Falls Me.	73	Box	44	122.00	2.77	2.21	97.00	.80	(25.00)	-	-
S	Mt.Wolf,Pa.-Downingtown,Pa.	71	Box	40	117.00	2.92	3.80	152.00	1.30	35.00	.88	23
	Ratio, S to V			.91	.96	1.05	1.72	1.57	1.63	-	-	-
V	Berlin,N.H.-Westbrook Cum. Me.	99	Box	61	143.00	2.35	5.40	327.00	2.30	184.00	3.02	56
S	Mt.Vernon,N.Y.-Burlington, N.J.	101	Box	27	120.00	4.44	4.60	107.00	1.04	(13.00)	-	-
	Ratio S to V			.44	.84	1.89	.85	0.32	.45	-	-	-

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APPENDIX A

Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

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V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Great Works, Me.-Plattsburgh N.Y.	354	Box	63	277.00	4.40	9.40	591.00	2.14	314.00	4.98	53
S	Ft.Edward, N.Y.-Niagara Falls, N.Y.	327	Box	40	196.00	4.89	7.00	280.00	1.43	84.00	2.10	30
	Ratio, S to V			.63	.71	1.11	.74	0.47	.67	.27	.42	.20
V	Rileys, Me.-Ticonderoga, N.Y.	351	Box	65	283.00	4.35	9.20	596.00	2.11	313.00	4.82	53
S	Spring Grove, Pa.-North Tonawanda, N.Y.	361	Box	49	216.00	4.40	7.60	373.00	1.73	157.00	3.20	42
	Ratio, S to V			.75	.76	1.01	.83	0.63	.82	.50	.66	.79
V	Rileys, Me.-Ticonderaga, N.Y.	351	Box	65	283.00	4.35	9.20	599.00	2.11	316.00	4.86	53
S	Richmond Byst, Va.-Williamsburg, Pa.	367	Box	27	194.00	7.17	7.60	239.00	1.06	45.00	1.67	19
	Ratio, S to V			.42	.68	1.65	.83	0.40	.50	.14	.34	.36
V	Erie, Pa.-Oswego, N.Y.	230	Box	44	169.00	3.84	10.40	458.00	2.70	289.00	6.57	63
S	Blue Island, Ill.-Monroe Mc., Mi.	246	Box	24	158.00	6.57	8.60	205.00	1.31	47.00	1.96	23
	Ratio, S to V			.55	.93	1.71	.83	.45	.49	.16	.30	.37
V	Green Bay, Wisc.-Menominee, Mich.	51	Box	53	98.00	1.85	2.60	137.00	1.41	39.00	.74	28
S	Pacific, Mo.-Alton, Ill.	52	Box	21	90.00	4.27	4.60	97.00	1.08	7.00	.33	7
	Ratio, S to V			.40	.92	2.31	2.31	1.77	.71	.18	.45	.25
V	Rothschild, Wisc.-Menominee, Mich.	134	Box	53	122.00	2.31	2.60	137.00	1.13	15.00	.28	11
S	Jefferson City, Mo.-Federal, Ill.	137	Box	20	108.00	5.41	6.20	125.00	1.15	17.00	.85	14
	Ratio, S to V			.38	.89	2.34	2.38	.91	1.02	1.13	3.04	1.27
V	Rothschild, Wisc.-Menominee, Mich.	134	Box	53	122.00	2.31	2.60	148.00	1.13	26.00	.49	18
S	Jefferson City, Mo.-Federal, Ill.	137	Box	22	108.00	4.92	6.20	136.00	1.26	28.00	1.27	21
	Ratio S to V			.42	.89	2.13	2.38	.92	1.12	1.08	2.59	1.17

APPENDIX A

Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

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V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Ashdown,Ark.-Peshtigo, Wisc.	971	Box	63	390.00	6.19	15.60	981.00	2.52	591.00	9.38	60
S	Dallas,Tex.-Green Bay, Wisc.	1058	Box	33	343.00	10.40	14.00	462.00	1.35	119.00	3.61	26
	Ratio, S to V			.52	.88	1.68	.90	.47	.54	.20	.38	.43
V	Menominee,Mich.- Green Bay,Wisc.	52	Box	64	117.00	1.82	2.60	165.00	1.43	48.00	.75	29
S	Pacific,Mo.-Alton,Ill.	52	Box	25	90.00	3.59	4.00	105.00	1.11	15.00	.60	14
	Ratio, S to V			.39	.77	1.97	1.54	.64	.78	.31	.80	.48
V	Menominee,Mich.-Green Bay,Wisc.	52	Box	64	117.00	1.82	2.60	165.00	1.43	48.00	.75	29
S	Pacific,Mo.-Alton,Ill.	52	Box	30	90.00	2.99	3.60	108.00	1.20	18.00	.60	17
	Ratio, S to V			.47	.77	1.64	1.38	.65	.84	.38	.80	.59
V	Rothschild,Wisc.-Green Bay,Wisc.	91	Box	53	117.00	2.21	2.60	137.00	1.18	20.00	.38	15
S	Green Bay, Wisc.-Wisc. Rapids,Wisc.	97	Box	25	101.00	4.05	3.00	75.00	.74	(26.00)	-	-
	Ratio, S to V			.47	.86	1.83	1.15	.55	.63	-	-	-
V	Appleton,Wi.-Stevens Pt. Wisc.	64	Box	49	101.00	2.05	2.60	127.00	1.27	26.00	.53	20
S	Appleton,Wi.-Stevens Pt. Wisc.	64	Box	43	99.00	2.30	3.00	129.00	1.30	30.00	.70	23
	Ratio, S to V			.88	.98	1.12	1.15	1.02	1.02	1.15	1.32	1.15
V	Rothschild,Wi.-EauClaire, Wisc.	124	Box	53	119.00	2.25	7.00	370.00	3.11	251.00	4.74	68
S	Menasha,Wi.-Merrill,Wi.	113	Box	38	124.00	3.26	4.40	166.00	1.35	42.00	1.11	25
	Ratio, S to V			.72	1.04	1.45	.63	.45	.43	.17	.23	.37

APPENDIX A

Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

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V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
V	Kimberly,Wi.-Neenah Menash, Wis.	10	Box	60	87.00	1.45	4.80	288.00	3.31	201.00	3.35	70
S	BlackRock,N.Y.-N. Tonawanda,N.Y.	10	Box	34	97.00	2.84	4.00	136.00	1.41	39.00	1.15	29
	Ratio, S to V			.57	1.11	1.96	.83	.47	.43	.19	.34	.41
V	Appleton,Wi.-Neenah Menash, Wi.	5	Box	63	86.00	1.36	1.60	100.00	1.18	14.00	.22	14
S	Appleton,Wi.-Neenah Menash, Wi.	5	Box	46	83.00	1.81	1.80	82.00	.99	(1.00)	-	-
	Ratio, S to V			.73	.97	1.33	1.12	.82	.84	-	-	-
V	Jackson,Ala.-Cincinnati,Oh.	687	Box	60	264.00	4.40	11.40	686.00	2.59	422.00	7.03	62
S	Franklin,Va.-Middletown,Oh.	654	Box	50	289.00	5.79	10.10	503.00	1.74	214.00	4.28	43
	Ratio S to V			.83	1.10	1.32	.89	.74	.67	.51	.61	.69
V	Lincoln,Me.-Potsdam,N.Y.	420	Box	61	285.00	4.68	11.20	683.00	2.39	398.00	6.52	58
V	Jackson,Ala.-Glens Falls N.Y.	1375	Box	60	512.00	8.53	19.20	1156.00	2.23	644.00	10.73	56
V	Mobile,Ala.-Ft.Edward N.Y.	1409	Box	72	561.00	7.79	19.40	1400.00	2.49	839.00	11.65	60
V	Mobile,Ala.-Ft.Edward N.Y.	1413	Box	76	576.00	7.57	19.20	1475.00	2.54	899.00	11.83	61
V	Selma,Ala.-Oswego,N.Y.	1139	Box	63	443.00	7.04	17.40	1096.00	2.47	653.00	10.37	60
V	Foley,Fla.-Front Royal Va.	840	Box	70	362.00	5.17	13.60	952.00	2.63	590.00	8.42	62
V	Columbia Jct.,Wa.-Plainwell,Mi.	2293	Box	60	807.00	13.45	21.40	1288.00	1.59	481.00	8.02	37
V	Birmingham,Ala.-Kalamazoo M.C.,Mich.	707	Box	96	364.00	3.80	12.80	1232.00	3.37	868.00	9.04	70
V	Everett,Wa.-Marinette,Wi.	2036	Box	61	727.00	11.91	19.00	1163.00	1.60	436.00	7.15	37

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Virgin Commodity (V): Woodpulp

Secondary Commodity (S): Waste Paper

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
V	Newberg,Ore.-Appleton, Wisc.	2050	Box	60	726.00	12.10	19.00	1140.00	1.57	414.00	6.90	36
V	Brunswick,Ga.-Merrill,Wi.	1268	Box	60	487.00	8.12	18.60	1116.00	2.29	629.00	10.48	56
V	Everett,Wa.-EauClare,Wi.	1801	Box	61	647.00	10.60	19.00	1163.00	1.79	516.00	8.46	44
V	Everett,Wa.,-Merrimac,Wi.	1989	Box	64	727.00	11.35	18.80	1213.00	1.65	486.00	7.59	40
V	Cosmopolis,Wa.-Toledo,Oh.	2429	Box	61	865.00	14.18	21.40	1305.00	1.51	440.00	7.21	34
V	Houston,Tex.-Hamilton,Oh.	1050	Box	76	470.00	6.19	10.00	776.00	1.62	306.00	4.03	39
V	Memphis,Tn.-Kingsport,Tn.	528	Box	30	181.00	6.03	13.00	390.00	2.12	209.00	6.97	54
S	Ft.Worth,Tex.-Ft.Edward N.Y.	1664	Box	47	596.00	12.68	17.60	836.00	1.39	240.00	5.11	29
S	Evadale,Tex.-Brownville, N.Y.	1595	Box	46	388.00	8.43	17.60	810.00	2.09	422.00	9.17	52
S	Hialeah,Fla.-Big Island Va.	960	Box	42	330.00	7.85	9.80	418.00	1.25	88.00	2.10	21
S	Evadale,Tex.-Menominee, Mich.	1215	Box	44	423.00	9.61	13.80	614.00	1.44	191.00	4.34	31
S	Houston,Tex.-Monroe,M.C Mich.	1190	Box	30	388.00	12.92	17.00	510.00	1.32	122.00	4.07	24
S	Clinton,Iowa-Ashland,Wi.	426	Box	41	195.00	4.75	8.20	333.00	1.73	138.00	3.37	41
S	Maspeth,N.Y.-Green Bay Wisc.	955	Box	41	379.00	9.25	12.80	525.00	1.38	146.00	3.56	28
S	Phil.Ontario,Pa.- S.High Pt. N.C.	441	Box	48	205.00	4.27	8.00	394.00	1.87	189.00	3.94	48
S	Denver,Col.-Pryor,Okla.	703	Box	50	284.00	5.67	10.00	500.00	1.76	216.00	4.32	43
S	Phoenix,Ariz.-Pryor,Okla.	1336	Box	65	518.00	7.97	9.80	637.00	1.23	119.00	1.83	19

APPENDIX A

Virgin Commodity (V): Glass Sand

Secondary Commodity (S): Cullet

Page 1 of 3

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Newport, N.J.-Vineland, N.J.	22	C.Hopper	74	102.00	1.38	1.39	103.00	1.01	1.00	.01	1
S	Creighton, Pa.-Ford City, Pa.	22	O.Hopper	73	101.00	1.39	3.78	276.00	2.72	175.00	2.40	63
	Ratio of S to V			.99	.99	1.01	2.72	2.68	2.69	175.00	240.00	63.00
V	Wedron, Ill.-Chicago, Ill.	72	C.Hopper	76	111.00	1.47	2.82	214.00	1.92	103.00	1.36	48
S	Milwaukee, Wi.-Chicago, Ill.	75	O.Hopper	50	120.00	2.40	4.00	200.00	1.67	80.00	1.60	40
	Ratio of S to V			.66	1.08	1.63	1.42	.93	.87	.78	1.18	.83
V	Ottawa, Ill.-Chicago, Ill.	80	C.Hopper	72	114.00	1.58	2.85	205.00	1.80	91.00	1.26	44
S	Milwaukee, Wi.-Chicago, Ill.	75	O.Hopper	50	120.00	2.40	4.00	200.00	1.67	80.00	1.60	40
	Ratio of S to V			.69	1.05	1.52	1.42	.98	.87	.88	1.27	.91
V	Glass Rock, Oh.-Crooksville, Oh.	20	C.Hopper	41	100.00	2.44	2.12	87.00	.87	(13.00)	-	-
S	E.St.Louis, Ill.-Alton, Ill.	18	O.Hopper	60	99.00	1.65	2.33	140.00	1.41	41.00	.68	29
	Ratio of S to V			1.46	.99	.68	1.10	1.61	1.62	-	-	-
V	Green Mtn., N.C.-Harrison N.J.	669	C.Hopper	55	338.00	6.15	8.47	466.00	1.38	128.00	2.33	27
V	Wedron, Ill.-Jersey City N.J.	941	C.Hopper	74	541.00	7.31	9.38	694.00	1.28	153.00	2.07	22
V	Wedron, Ill.-Jersey City N.J.	941	C.Hopper	73	539.00	7.38	9.32	680.00	1.26	141.00	1.93	21
V	Ottawa, Ill.-Jersey City N.J.	936	C.Hopper	74	539.00	7.28	9.41	696.00	1.29	157.00	2.12	23
V	Green Mtn, N.C.-High Bridge N.J.	647	C.Hopper	55	332.00	6.04	9.00	495.00	1.49	163.00	2.96	33
V	Berkely Springs, W.V.-Ford City, Pa.	219	C.Hopper	65	194.00	2.98	4.82	313.00	1.61	119.00	1.83	38
V	Berkely Springs, W.V.-Vienna, W.V.	251	C.Hopper	72	213.00	2.95	5.00	360.00	1.69	147.00	2.04	41

Virgin Commodity (V): Glass Sand

Secondary Commodity (S): Cullet

V S	Origin	Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
V	Goshen,Va.	Owens,W.V.	201	C.Hopper	72	189.00	2.62	3.61	260.00	1.38	71.00	.99	27
V	Ottawa,Ill.	Cleveland,Oh.	391	C.Hopper	52	251.00	4.83	6.25	325.00	1.29	74.00	1.42	23
V	Wedron,Ill.	Columbus,Oh.	358	C.Hopper	72	256.00	3.56	4.81	346.00	1.35	90.00	1.25	26
V	Webb City,Mo.	Chicago,Ill.	563	C.Hopper	40	299.00	7.48	7.55	302.00	1.01	3.00	.08	1
V	Pacific,Mo.	Nashville,Tn.	349	C.Hopper	62	204.00	3.30	5.53	343.00	1.68	139.00	2.24	41
V	Kosse,Tex.	Laredo,Tex.	355	C.Hopper	60	232.00	3.86	5.88	353.00	1.52	121.00	2.02	34
V	Mill Creek,Oh.	Berkeley, Calif.	1876	C.Hopper	76	886.00	11.66	13.13	998.00	1.13	112.00	1.47	11
V	Mill Creek,Oh.	Oakland Calif.	1875	C.Hopper	80	903.00	11.28	13.93	1114.00	1.23	211.00	2.64	19
V	Mill Creek,Oh.	Oakland Calif.	1875	C.Hopper	76	886.00	11.65	13.14	999.00	1.13	113.00	1.49	11
V	Idyllwild,Ca.	Santa Clara,Ca.	480	C.Hopper	75	297.00	3.95	5.61	421.00	1.42	124.00	1.65	29
S	Detroit,Mi.	Rutherford, N.J.	646	O.Hopper	61	354.00	5.81	9.43	575.00	1.62	221.00	3.62	38
S	Detroit,Mi.	Rutherford, N.J.	646	O.Hopper	74	374.00	5.05	9.42	697.00	1.87	323.00	4.36	46
S	Detroit,Mi.	Rutherford, N.J.	646	O.Hopper	69	366.00	5.31	9.35	645.00	1.76	279.00	4.04	43
S	Crestline,Oh.	Rutherford, N.J.	615	O.Hopper	75	361.00	4.82	9.02	676.00	1.87	315.00	4.20	47
S	Toledo,Oh.	Bridgeton,N.J.	636	O.Hopper	65	356.00	5.48	11.80	768.00	2.15	412.00	6.34	54
S	Glenn,Ill.	Bremen,Oh.	335	O.Hopper	73	237.00	3.25	8.18	597.00	2.52	360.00	4.93	60

Virgin Commodity (V): Glass Sand

Secondary Commodity (S): Cullet

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V S	Origin	Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
S	Luzerne Co.,Pa.	Columbus, Oh.	487	O.Hopper	61	290.00	4.75	10.46	638.00	2.20	348.00	5.70	55
S	Lemont,Pa.	Bluffton,Ind.	489	O.Hopper	56	285.00	5.09	6.20	347.00	1.22	62.00	1.11	18
S	Crestline,Oh.	Streator,Ill.	329	O.Hopper	58	223.00	3.85	8.78	509.00	2.34	286.00	4.93	56
S	Detroit,Mi.	Jackson,Miss.	899	O.Hopper	30	342.00	11.40	18.33	550.00	1.61	208.00	6.93	38
S	Toledo,Oh.	Jackson,Miss.	847	O.Hopper	73	405.00	5.54	15.36	1121.00	2.77	716.00	9.81	64
S	Lathrop,Ca.	Workman,Ca.	395	O.Hopper	93	272.00	2.93	5.19	483.00	1.77	211.00	2.27	44
S	Milwaukee,Wi.	Streator,Ill.	148	O.Hopper	50	133.00	2.67	8.00	400.00	3.00	267.00	5.34	67
S	Cleveland,Oh.	Wharton,N.J.	405	O.Hopper	70	265.00	3.78	10.40	728.00	2.75	463.00	6.61	64

APPENDIX A

Virgin Commodity (V): Primary Aluminum Ingot

Secondary Commodity (S): Aluminum Scrap

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Massena,N.Y.-Cleveland,Oh.	487	Box	42	260.00	6.18	12.80	538.00	2.07	278.00	6.62	52
S	Fairmont,W.V.-Oswego,N.Y.	466	O.Hopper	40	253.00	6.33	14.00	560.00	2.21	287.00	7.67	51
	Ratio, S to V			.95	.98	1.02	1.09	1.04	1.07	1.03	1.16	.98
V	Malaga,Wa.-Cleveland,Oh.	2310	Box	50	764.00	15.28	31.00	1559.00	2.02	795.00	15.90	51
S	Intalco,Wa.-Cleveland,Oh.	2430	O.Hopper	20	786.00	39.30	50.40	1008.00	1.28	222.00	11.10	22
	Ratio, S to V			.40	1.03	2.57	1.63	.65	.63	.28	.70	.43
V	Intalco,Wa.-Warren,Oh.	2483	Box	76	969.00	12.76	31.00	2349.00	2.42	1380.00	18.16	59
S	Intalco,Wa.-Cleveland,Oh.	2430	O.Hopper	20	786.00	39.30	50.40	1008.00	1.28	222.00	11.10	22
	Ratio, S to V			.26	.81	3.08	1.63	.43	.53	.16	.61	.37
V	Intalco,Wa.-Youngstown,Oh.	2494	Box	52	834.00	16.03	31.00	1612.00	1.93	778.00	14.97	48
S	Intalco,Wa.-Cleveland,Oh.	2430	O.Hopper	20	786.00	39.30	50.40	1008.00	1.28	222.00	11.10	22
	Ratio, S to V			.38	.94	2.45	1.63	.63	.66	.29	.74	.46
V	Intalco,Wa.-Youngstown,Oh.	2494	Box	50	834.00	16.67	31.00	1550.00	1.86	716.00	14.33	46
S	Intalco,Wa.-Cleveland,Oh.	2430	O.Hopper	20	786.00	39.30	50.40	1008.00	1.28	222.00	11.10	22
	Ratio, S to V			.40	.94	2.36	1.63	.65	.69	.31	.77	.48
V	Longview,Wa.-Omal,Oh.	2661	Box	63	944.00	14.98	31.00	1953.00	2.07	1009.00	16.02	52
S	Intalco,Wa.-Cleveland,Oh.	2430	O.Hopper	20	786.00	39.30	50.40	1008.00	1.28	222.00	11.10	22
	Ratio, S to V			.32	.83	2.62	1.63	.52	.62	.22	.69	.40
V	Lafayette,Ind.-Cressons, Pa.	722	Box	46	328.00	7.14	18.20	838.00	2.55	510.00	11.09	61
V	Conalco,Tn.-Lancester,Pa.	963	Box	51	379.00	7.44	19.60	1000.00	2.63	621.00	12.16	62
V	Conalco,Tn.-Greenville,Pa.	685	Box	59	300.00	5.09	15.60	920.00	3.06	620.00	10.51	67
V	Conalco,Tn.-Shelbyville, Ky.	312	Box	51	146.00	2.87	12.20	622.00	4.25	476.00	9.33	77
V	Jones Mill,Ark.-Louisville, Ky.	551	Box	51	242.00	4.74	11.00	561.00	2.32	319.00	6.26	57

APPENDIX A

Virgin Commodity (V): Primary Aluminum Ingot

Secondary Commodity (S): Aluminum Scrap

Page 2 of 4

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Mead,Wash.-Cleveland,Oh.	2148	Box	52	730.00	14.04	31.00	1612.00	2.20	882.00	16.96	55
V	Chalmette,La.-Campbell, Oh.	1128	Box	53	413.00	7.79	17.00	901.00	2.18	488.00	9.21	54
V	Sandow,Tex.-Warrick,Ind.	866	Box	42	283.00	6.73	20.80	874.00	3.09	591.00	14.07	68
V	Mead,Wash.-Chicago,Ill.	1818	Box	50	611.00	12.22	23.40	1170.00	1.91	559.00	11.18	48
V	Intalco,Wash.-Beven,Ill.	2109	Box	59	741.00	12.56	23.40	1380.00	1.86	639.00	10.84	46
V	Conalco,Tenn.-Columbia, Tenn.	200	Box	91	135.00	1.48	2.57	234.00	1.74	99.00	1.09	42
V	Conalco,Tenn-Jackson,Tenn.	61	Box	94	85.00	.90	2.20	207.00	2.44	122.00	1.30	59
V	Malaga,Wash.-Waterloo,Ia.	1728	Box	41	529.00	12.90	23.40	959.00	1.81	330.00	10.50	34
V	Malaga,Wash.-Riverdale,Ia.	1860	Box	57	651.00	11.42	23.20	1319.00	2.03	668.00	11.78	51
V	Pt.Comfort,Tex.- Davenport, Iowa	1127	Box	69	441.00	6.39	11.60	798.00	1.81	357.00	5.21	45
V	Conkelly,Mont.-Seattle , Wash.	587	Box	74	301.00	4.06	10.80	799.00	2.66	498.00	6.74	62
V	Mead,Wash.-Seattle,Wash.	318	Box	73	209.00	2.86	8.80	642.00	3.08	433.00	5.93	67
V	Malaga,Wash.-Seattle, Wash.	162	Box	54	145.00	2.69	6.20	335.00	2.30	190.00	3.51	57
V	Intalco,Wash.-Merced,Calif.	938	Box	50	363.00	7.25	16.60	830.00	2.29	467.00	9.34	56
V	Mead,Wash.-Los Angeles, Calif.	1341	Box	43	453.00	10.54	16.60	715.00	1.57	262.00	6.09	37
V	Intalco,Wash.-Los Angeles, Calif.	1271	Box	50	457.00	9.13	16.60	831.00	1.82	374.00	7.48	45

APPENDIX A

Virgin Commodity (V): Primary Aluminum Ingot

Secondary Commodity (S): Aluminum Scrap

Page 3 of 4

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
S	Cleveland,Oh.-Rooseveltown, N.Y.	501	O.Hopper	16	243.00	15.22	15.40	244.00	1.01	1.00	.18	0
S	Toledo Olive,Oh.-Oswego, N.Y.	428	O.Hopper	48	253.00	5.27	12.40	597.00	2.35	344.00	7.13	58
S	Flint,Mich.-Cleveland,Oh.	206	O.Hopper	20	156.00	7.80	10.80	216.00	1.38	60.00	3.00	28
S	Cableton,Mi.-Cleveland,Oh.	293	O.Hopper	40	197.00	4.92	10.20	408.00	2.07	211.00	5.28	52
S	Luzerne Co.,Pa.-Cleveland Davenport,Oh.	428	O.Hopper	43	248.00	5.77	12.40	528.00	2.15	280.00	6.63	53
S	Corliss,Pa.-Sandusky,Oh.	192	O.Hopper	33	157.00	4.77	9.60	317.00	2.01	160.00	4.83	50
S	Akron,Oh.-Sandusky,Oh.	78	O.Hopper	20	116.00	5.80	7.60	152.00	1.31	36.00	1.80	24
S	Alma,Mich.-Toledo,Oh.	144	O.Hopper	36	142.00	3.94	8.80	315.00	2.23	173.00	4.86	55
S	Toledo Olive,Oh.-Butler, Ind.	70	O.Hopper	54	119.00	2.20	6.40	347.00	2.91	228.00	4.20	66
S	Burns City,In.-Chicago, Ill.	240	O.Hopper	62	185.00	2.98	10.60	652.00	3.56	467.00	7.62	72
S	Evansville,In.-Chicago, Ill.	280	O.Hopper	20	179.00	8.95	12.40	248.00	1.35	69.00	3.45	28
S	N.Chattanooga,Tn.-Chicago, Ill.	592	O.Hopper	27	254.00	9.40	18.00	486.00	1.91	232.00	8.60	48
S	Minneapolis,Minn.-Chicago, Ill.	401	O.Hopper	21	198.00	9.45	11.00	228.00	2.07	30.00	1.55	13
S	Danbury,Conn.-Chicago TVT, Ill.	900	O.Hopper	11	354.00	32.20	23.40	263.00	-	(91.00)	(8.80)	-

APPENDIX A

Virgin Commodity (V): Primary Aluminum Ingot

Secondary Commodity (S): Aluminum Scrap

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V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
S	New Haven, Conn.-Chicago U.S.Yd., Ill.	945	O.Hopper	23	393.00	17.10	22.80	524.00	1.33	131.00	5.70	25
S	Danbury, Conn.-Chicago U.S. Yd., Ill.	900	O.Hooper	11	354.00	32.20	29.90	329.00	-	(25.00)	(2.30)	-
S	New Haven, Conn.-E.Alton, Ill.	1116	O.Hopper	56	532.00	9.51	21.40	1198.00	2.25	666.00	11.89	56
S	Sacramento, Calif.-Oakland, Calif.	88	O.Hopper	50	125,00	2.49	4.80	240.00	1.93	115.00	2.31	48
S	Los Angeles, Calif.-Mira-Loma, Calif.	43	O.Hopper	19	106.00	5.55	4.00	75.00	-	(31.00)	(1.55)	-
S	Pittsburg, Calif.-Riverside, Calif.	488	O.Hopper	27	239.00	8.85	12.40	332.00	1.40	93.00	3.55	28
S	Oakland, Calif.-Norco, Cal.	520	O.Hopper	49	264.00	6.61	9.00	355.00	1.36	91.00	2.39	26

APPENDIX A

Virgin Commodity (V): Natural & Synthetic Rubber

Secondary Commodity (S): Scrap Rubber

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V S	Origin	Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Hudson Co.,N.J.	Barberton, Oh.	544	Box	29	246.00	8.47	14.50	418.00	1.71	172.00	5.93	41
S	Medford, N.J.	Akron, Oh.	501	Box	30	235.00	7.83	14.00	426.00	1.78	191.00	6.37	45
	Ratio, S to V				1.03	.96	.92	.97	1.02	1.04	.90	1.07	1.10
V	Hudson Co.,N.J.	Akron,Oh.	537	Box	20	230.00	11.52	14.60	297.00	1.27	67.00	3.35	23
S	Medford,N.J.	Akron,Oh.	501	Box	30	235.00	7.83	14.00	426.00	1.78	191.00	6.37	45
	Ratio S to V				1.50	1.02	.68	.96	1.48	1.40	2.85	1.90	1.96
V	Moraine,Oh.	Akron,Oh.	184	Box	29	144.00	4.98	9.83	285.00	1.97	141.00	4.86	49
S	Corry,Pa.	Norwalk,Oh.	186	Box	15	135.00	9.02	11.40	171.00	1.26	36.00	2.38	21
	Ratio S to V				.52	.94	1.81	1.16	.60	.64	.26	.49	.43
V	Hudson Co.,N.J.	Akron,Oh.	537	Box	28	242.00	8.65	14.60	413.00	1.69	171.00	6.11	41
S	Medford,N.J.	Akron, Oh.	501	Box	30	235.00	7.83	14.00	426.00	1.78	191.00	6.37	45
	Ratio S to V				1.07	.97	.91	.96	1.03	1.05	1.12	1.04	1.10
V	Jersey City,N.J.	Akron,Oh.	537	Box	24	242.00	10.09	17.60	429.00	1.74	187.00	7.51	44
S	Medford,N.J.	Akron,Oh.	501	Box	30	235.00	7.83	14.00	426.00	1.78	191.00	6.37	45
	Ratio S to V				1.25	.97	.78	.79	.87	1.02	1.02	.85	1.02
V	N.Y.,N.Y.	E.St.Louis,Ill.	1027	Box	28	379.00	13.54	20.60	570.00	1.52	191.00	7.06	34
S	Chester,Pa.	E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V				1.11	.95	.86	1.19	1.32	1.39	2.05	1.82	1.53
V	Phila.Pa.	Barberton,Oh.	472	Box	28	224.00	8.00	14.80	418.00	1.85	194.00	6.80	46
S	Akron,Oh.	Freeport,Ill.	450	Box	65	237.00	3.65	12.60	815.00	3.45	578.00	8.95	71
	Ratio S to V				2.32	1.06	.46	.85	1.95	1.86	2.98	1.32	1.54
V	Akron,Oh.	Pepperell,Ala.	807	Box	43	301.00	7.00	20.84	896.00	2.98	595.00	13.84	66
S	Akron,Oh.	Tuscaloosa,Ala.	776	Box	35	278.00	7.94	20.40	724.00	2.57	446.00	12.46	62
	Ratio S to V				.81	.92	1.13	.98	.81	.86	.75	.90	.94

APPENDIX A

Virgin Commodity (V): Natural & Synthetic Rubber

Secondary Commodity (S): Reclaimed Rubber

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V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Contribution to Fixed Cost and ROI Per Ton $	Contribution to Fixed Cost and ROI % of Revenue
V	Moraine,Oh.-Akron, Oh.	184	Box	29	144.00	4.98	9.83	285.00	1.97	141.00	4.86	49
S	Akron,Oh.-Jackson Mc.,Mich.	202	Box	71	179.00	2.53	7.58	538.00	3.00	359.00	5.06	67
	Ratio S to V			2.45	1.24	.51	.77	1.89	1.52	2.55	1.04	1.37
V	Hudson Co.,N.J.-St.Marys,Oh.	704	Box	24	281.00	11.73	16.75	402.00	1.43	121.00	5.02	30
S	Naugatuck,Ct.-Detroit Mc, Mich.	673	Box	50	320.00	6.39	15.98	799.00	2.50	479.00	9.59	60
	Ratio S to V			2.08	1.14	.54	.95	1.99	1.74	3.96	1.91	2.00
V	HudsonCo.,N.J.-Chicago,Ill.	878	Box	26	333.00	12.81	18.92	492.00	1.48	159.00	6.11	32
S	Chester,Pa.-E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V			1.19	1.08	.91	1.29	1.53	1.43	2.46	2.11	1.63
V	HudsonCo.,N.J.-Freeport,Ill.	985	Box	22	327.00	14.86	19.00	418.00	1.28	91.00	4.14	22
S	Chester,Pa.-E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V			1.41	1.10	.78	1.29	1.80	1.65	4.30	3.11	2.36
V	Hudson Co.,N.J.-Morris,Ill.	913	Box	37	359.00	9.69	18.68	691.00	1.93	332.00	8.99	48
S	Chester,Pa.-E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V			.84	1.01	1.20	1.31	1.09	1.09	1.18	1.43	1.08
V	Hudson Co.,N.J.-Detroit, Mich.	652	Box	54	322.00	5.96	15.90	895.00	2.67	573.00	10.61	64
S	Naugatuck,Ct.-Detroit, Mich.	673	Box	50	320.00	6.39	15.98	799.00	2.50	479.00	9.59	60
	Ratio S to V			.93	.99	1.07	1.00	.89	.94	.84	.90	.94
V	Mamaroneck,N.Y.-Chicago, Ill.	920	Box	32	359.00	11.21	23.36	743.00	2.08	384.00	12.15	52
S	Chester,Pa.-E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V			.97	1.01	1.04	1.05	1.01	1.01	1.02	1.06	1.00
V	N.Y.,N.Y.-E.St.Louis,Ill.	1027	Box	28	379.00	13.54	20.60	570.00	1.52	191.00	7.06	34
S	Chester,Pa.-E.St.Louis,Ill.	945	Box	31	360.00	11.63	24.50	751.00	2.11	391.00	12.87	52
	Ratio S to V			1.11	.95	.86	1.19	1.32	1.39	2.05	1.82	1.53

Virgin Commodity (V): Natural & Synthetic Rubber

Secondary Commodity (S): Reclaimed Rubber

V S	Origin Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI		
										Per Car $	Per Ton $	% of Revenue
V	Tacoma,Wa.-Decatur,Ill.	2161	Box	62	750.00	12.09	33.20	2050.00	2.75	1300.00	21.11	63
V	Baytown,Tex.-Detroit,Mich.	1250	Box	72	535.00	7.43	14.80	1065.00	1.99	530.00	7.36	50
V	Odessa,Tex.-Akron,Oh.	1502	Box	86	670.00	7.79	14.80	1271.00	1.90	601.00	6.99	47
V	Amarillo,Tex.-Brittain,Oh.	1285	Box	82	576.00	7.02	10.20	836.00	1.45	260.00	3.18	31
V	Odessa,Tex.-Waco,Tex.	365	Box	85	220.00	2.59	7.00	598.00	2.70	378.00	4.45	63
V	Borger,Tex.-Oakland,Calif.	1540	Box	44	510.00	11.59	32.40	1426.00	2.80	916.00	20.82	64
V	Orange,Tex.-L.A.,Calif.	1739	Box	71	677.00	9.54	28.40	2018.00	2.98	1341.00	18.89	66
V	Louisville,Ky.-Watson,Cal.	2216	Box	43	656.00	15.25	40.20	1749.00	2.63	1093.00	24.95	62
V	Louisville,Ky.-L.A.Co.,Cal.	2186	Box	40	633.00	15.83	39.20	1568.00	2.48	935.00	23.37	60
V	Port Neches,Tx.-Torrance, Calif.	1741	Box	50	583.00	11.66	30.00	1500.00	2.57	917.00	18.34	61
V	Port Neches,Tx.-Texarkana, Tx.	287	Box	67	178.00	2.66	5.20	348.00	1.95	170.00	2.54	49
V	Orange,Tx.-Shumaker,Ark.	314	Box	47	170.00	3.61	11.62	551.00	3.22	381.00	8.01	69
V	N.Baton Rouge,La.-Shumaker, Ark.	290	Box	41	181.00	4.42	10.90	447.00	2.47	266.00	6.49	60
V	Orange ,Tx.-Camden,Ark.	308	Box	71	188.00	2.65	7.60	542.00	2.87	354.00	4.99	65
S	Naugatuck,Ct.-Detroit,Mi.	673	Box	49	318.00	6.49	16.92	829.00	2.61	511.00	10.43	62
S	Akron,Oh.-Woodburn Good, Ind.	186	Box	40	152.00	3.81	6.00	240.00	1.57	88.00	2.20	37
S	Akron,Oh.-Gadsden,Ala.	667	Box	56	282.00	5.04	15.40	858.00	3.05	576.00	10.29	67
S	Bucyrus,Oh.-Lineville,Ala.	666	Box	51	272.00	5.33	14.20	720.00	2.66	448.00	8.78	62
S	Akron,Oh.-Topeka,Ks.	824	Box	66	378.00	5.73	15.40	1016.00	2.69	638.00	9.67	63

Virgin Commodity (V): Natural & Synthetic Rubber

Secondary Commodity (S): Scrap Rubber

APPENDIX A

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V S	Origin	Destination	Length of Haul (miles)	Type of Car	Tons Per Car	Cost Per Car $	Cost Per Ton $	Rate Per Ton $	Revenue Per Car $	Ratio of Rate To Cost Per Ton (times)	Contribution to Fixed Cost and ROI Per Car $	Per Ton $	% of Revenue
S	Ft.Wayne,Tx.	E.St.Louis, Ill.	711	Box	40	210.00	5.25	10.40	416.00	1.98	206.00	5.15	49
S	Beaumont,Tx.	E.St.Louis, Ill.	831	Box	40	231.00	5.78	11.80	472.00	2.04	241.00	6.02	51
S	Chicago,Ill.	E.St.Louis, Ill.	284	Box	40	182.00	4.55	6.20	248.00	1.36	66.00	1.65	27
S	Corry,Pa.	Chicago Polk,Ill.	464	Box	15	205.00	13.65	18.40	276.00	1.35	71.00	4.73	26
S	Houston,Tx.	Brenham,Tx.	70	Box	20	107.00	5.33	8.00	160.00	1.50	53.00	2.65	33

Appendix B

REGRESSION ANALYSIS, CONTRIBUTION AS A PERCENTAGE OF REVENUE

An equation of the form

$$Y = a + bx$$

was assumed to fit percent contribution to revenue (Y) as a linear function of mileage (x) for each of eleven commodities.

The data were plotted prior to any curve fitting in order to visualize the nature of the functional relationships. It was immediately evident that in each case these were varying numbers of aberrant points which made difficult the employment of any regression analysis.

Further investigation revealed that there existed a mixture of populations such as the inclusion of intrastate as well as interstate shipments or multiple moves to the same plant. Each move was reexamined and a "pure" population of interstate moves was obtained.

The possibility of fitting curves in segments defined by mileage breaks was considered, but discarded as a practical expression of the relationships because of the large discontinuities that appeared at the boundaries. Forcing continuity, which was possible, would have resulted in unrepresentative fits with a high degree of artificiality.

Finally, the use of a transformation of one or both variables was attempted as a means of securing better fits between both variables. No transformation, common to all sets of data, was found that contributed significantly to linearizing or otherwise smoothing the relationship.

The functional form finally adopted was linear. Nonlinear terms were found to be without statistical significance in several of the sets of data. It is believed that a single functional form of relationship should be used for all data to facilitate comparisons of the coefficient showing the change in percent contribution for a unit change in mileage; such a comparison would not be feasible if different functional relationships were used for different commodities.

The number of observations available ranged from seven for scrap rubber to 48 for woodpulp. Of the original total number of available observations, a varying number of moves were omitted from the calculations in the fitting process for reasons discussed in Chapter III. Let n refer to the net number of observations retained and used. As may be inferred from Appendix Table 1, the net number of observations ranged from seven for scrap rubber to 27 for aluminum ingots and natural and synthetic rubber. The mean sample size was 19.6 observations.

For each commodity the regression coefficients were estimated from the formulas

$$\hat{a} = \frac{\Sigma Y \, \Sigma x^2 - \Sigma x \, \Sigma xY}{N\Sigma x^2 - (\Sigma x)^2}$$

and

$$\hat{b} = \frac{N\Sigma xY - \Sigma x\Sigma Y}{N\Sigma x^2 - (\Sigma x)^2}$$

where the summation in each case runs over the n observations retained for that commodity.

At the same time, two related measures were calculated. The correlation coefficient

$$r = \frac{N\Sigma xY - \Sigma x\Sigma Y}{\sqrt{N\Sigma x^2 - (\Sigma x)^2} \, \sqrt{N\Sigma Y^2 - (\Sigma Y)^2}}$$

Appendix B

TABLE 1

REGRESSION ANALYSIS BY COMMODITY

Commodity	Number of Observations Total	Number of Observations Retained	Regression Equation	t Value	Correlation Coefficient	Std. Error of Estimate
Iron Ore	26	24	Y=53.22-.0532x	-3.70**	-.6186	8.77
I&S Scrap	30	26	Y=55.17-.0141x	-2.08*	-.3903	9.59
Woodpulp	48	26	Y=64.28-.0106x	-5.25**	-.7288	7.51
Waste Paper	42	16	Y=48.19-.0172x	-4.43**	-.7641	7.38
Glass Sand	21	17	Y=37.57-.0136x	-5.84**	-.8360	5.62
Cullet	17	17	Y=50.59-.0045x	- .35	-.0448	13.99
Aluminum Ingot	27	27	Y=60.51-.0052x	-2.44*	-.4387	9.06
Aluminum Scrap	24	20	Y=47.16-.0100x	-1.83*	-.3972	16.21
Nat. & Synth. Rubber	29	27	Y=47.85-.0037x	.94	.1881	12.63
Scrap Rubber	7	7	Y=20.71-.0351x	2.93	.7944	8.10
Reclaimed Rubber	10	9	Y=74.25-.0176x	-2.90*	-.7334	3.71

* Significant at .05 level of significance.

** Significant at .01 level of significance.

Appendix C

METHODOLOGY USED TO EVALUATE COMPATIBILITY OF STUDY MOVES WITH RANDOMLY SELECTED MOVES

A second degree curve of the form

$$y = b_o + b_1x + b_2x^2$$

was used to fit revenue per ton (y) to mileage (x) for the "study moves" for each of eleven commodities. To investigate whether the study moves which were subjectively chosen were consistent with a population of all moves for that commodity, a random sample of additional moves was selected. In each case a sample of about size twenty was desired; the actual range of sample sizes ran from nine to twenty-two with an average of about eighteen.

Given the fitted curve of the form displayed above, an estimate of the variance is

$$\hat{\sigma}_s^2 = \frac{\Sigma(y-\hat{b}_o-\hat{b}_1x-\hat{b}_2x^2)^2}{n_s-3}$$

where the summation is taken over all n_s study moves, and b_0, b_1, and b_2 represent the estimates derived from the set of study moves.

For the random sample we computed

$$\hat{\sigma}_r^2 = \frac{\Sigma(y-\hat{b}_o-\hat{b}_1x-\hat{b}_2x^2)^2}{n_r}$$

based on the n_r moves in the random sample.

The coefficients are those that were estimated from the study moves; hence no degrees of freedom are lost in computing $\hat{\sigma}_r^2$.

If both sets of moves belong to the same population of moves in terms of the relationship between revenue per ton and mileage, the $\hat{\sigma}_s^2$ and $\hat{\sigma}_r^2$ are independent estimates of the same unknown variance. Alternatively $\hat{\sigma}_r^2$ would be expected to be larger than $\hat{\sigma}_s^2$ if they were derived from different populations.

A test of the hypothesis that both variance estimates are equivalent may be constructed by calculating

$$F = \frac{\hat{\sigma}_r^2}{\hat{\sigma}_s^2}$$

which, under the null hypothesis, has the F distribution with n_r and (n_s-3) degrees of freedom.

The accompanying table displays these calculations for each of the eleven commodities. It may be seen that only one of the eleven commodities showed a significant difference at the 5% level, and that was only marginally greater than the 5% value. That commodity was iron ore.

It is well within the bounds of chance to encounter one F ratio out of eleven to be significant at the 5% level, when in fact, the null hypothesis is true. We must conclude therefore that the statistical evidence is constant with the hypothesis that the study moves are compatible with the entire population of moves for each commodity.

Appendix C

COMPARISON OF RANDOMLY SELECTED MOVES WITH STUDY MOVES BY COMMODITY

Commodity	Study Moves		Random Moves			
	n_s	$\hat{\sigma}_s^2$	n_r	$\hat{\sigma}_r^2$	$F=\hat{\sigma}_r^2/\hat{\sigma}_s^2$	$F_{.05,\, n_r,\, n_s-3}$
Aluminum Ingots	27	10.61	22	9.88	.931	2.01
Aluminum Scrap	24	7.35	18	10.95	1.490	2.13
Nat. & Synth. Rubber	29	25.29	20	29.02	1.147	1.99
Reclaimed Rubber	10	4.35	17	3.93	.903	3.48
Scrap Rubber	7	15.82	9	4.21	.266	6.00
Glass Sand	21	.34	20	.62	1.823	2.19
Cullet	17	4.27	18	4.50	1.054	2.42
Iron Ore	26	.076	17	.162	2.132*	2.10
Iron & Steel Scrap	30	3.13	15	4.34	1.387	2.06
Woodpulp	48	3.40	20	5.04	1.482	1.86
Wastepaper	42	8.04	20	1.21	.150	1.84

* Significant at 5% level.

is a dimensionless quantity representing a measure of how well the linear relationship fits the data. The quantity, r, varies in magnitude between 0, representing a complete absence of a linear relationship, and 1, indicating a perfect linear relationship.

The other measure of goodness of fit is the standard error of estimate

$$s_y = \sqrt{\frac{\Sigma(Y-\hat{a}-\hat{b}x)^2}{n-2}}$$

which is a root-mean-square estimate of deviations of actual observations from the fitted line. The standard error of estimate has the same dimensions as Y, i.e. percent contribution.

Finally, one can calculate

$$t = \frac{\hat{b}}{s_y}\sqrt{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}$$

to assess the statistical significance of the difference of the slope of the fitted lines from zero. High negative values are indicative of large negative slopes showing a diminishing percent contribution with increasing mileage. The quantity t is known as Student's t with (n-2) degrees of freedom. A one-sided test of significance is used since only large negative values of $\hat{b}$ are of interest. A significance level of .01, say, should be interpreted in the sense that the probability is .01 or less that as large or larger a negative value for $\hat{b}$ would be obtained by chance if the "true" slope were zero. The significance level varies with the number of degrees of freedom.

The accompanying table displays the number of observations, the linear regression equation, r, t, and s_y for each commodity.

Levels of significance of t, using a one-sided test, are indicated by asterisks.

APPENDIX D

Appendix (Table) D illustrates the traffic carried by regulated landborne carriers for the year 1969 for nine of the twelve study commodities; for three commodities, aluminum scrap, cullet and glass sand comparable data are not available.

RAIL AND REGULATED TRUCK TRAFFIC
BY COMMODITY, 1969

STCC No.	Commodity	Rail Freight Terminated		Truck Freight Terminated		Rail % of Total
		Carloads	Tons	Truckloads	Tons	
08423	Crude Natural Rubber	16,846	681,146	9,138	154,149	81.5
101	Iron Ores	986,045*	79,682,920*	723	10,431	99.9
26111	Woodpulp	144,358	8,400,976	10,337	190,729	97.7
28212	Synthetic Rubber	41,856	2,418,243	44,257	758,415	76.1
303	Reclaimed Rubber	2,459	102,177	2,984	48,643	67.7
3334	Primary Aluminum	54,773	3,096,830	18,238	303,368	91.0
40211	Iron & Steel Scrap	532,168	29,133,716	7,395	149,654	99.4
4024	Paper Waste & Scrap	122,576	4,173,637	1,156	17,358	99.5
4026	Rubber, Plastic Scrap and Waste	12,335	292,306	2,284	30,908	90.4

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*Totals for Iron Ore Originated are 1,358,838 carloads and 104,700,694 tons.

Sources: Freight Commodity Statistics, Class I Railroads, Year Ended December 31, 1969, and Freight Commodity Statistics of Class I Motor Carriers of Property Operating in Intercity Service - Common and Contract - in the United States, Calendar Year 1969, both published by Bureau of Accounts, Interstate Commerce Commission.

Appendix E

EQUIVALENCY FORMULAS

Equivalency formulas are applicable to the computation of transportation price and delivered cost effects of the alternate use of virgin or secondary materials.

The comparative computations reflect equivalent quantities of virgin and secondary materials needed to produce either the same unit of manufactured product or pure material.

I. To produce an equivalent quantity of steel ingot, the requirements are:[1]

Virgin materials, pounds			Secondary material, pounds	
Iron ore 60% Fe content	3,167			
Limestone	425			
Coal	602			
Total	4,194	OR	Steel scrap, 95% Fe content	2,000

II. To produce an equivalent quantity of paperboard production, the requirements are:

Woodpulp	88 lbs.	OR	Waste Paper	100 lbs.

III. To produce an equivalent quantity of glass-making batch, the requirements are:

Glass sand	56.3			
Soda ash	18.7			
Limestone	16.5			
Feldspar	8.5			
Total	100.0 lbs.	OR	Cullet	100 lbs.

IV. To produce an equivalent quantity of secondary aluminum ingot, the requirements are:

Primary Aluminum Ingot	92 lbs.	OR	Scrap	100 lbs.

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[1] Ignores heating coal or substitute source of heating energy.

V. To produce a rubber batch for tire manufacturing, virgin and secondary are substitutable as follows:

Dry natural or synthetic rubber	47.0	pounds		
Carbon black	20.0	pounds		
Zinc oxide	3.5	pounds		
Sulphur	3.0	pounds		
Miscellaneous materials	26.5	pounds		
Total	100.0	OR	Reclaimed	100 lbs.

Commodity Prices Used in Report Analyses

IRON AND STEEL

Iron Ore - Domestic

Price per net ton, Mesabi Range, at rail of vessel, lower lake port, adjusted to 60% iron content (see computation on page 6 of this appendix).	$ 11.55

Iron Ore - Imported

Price per net ton, pellets, loaded in cars at East Coast ports, adjusted to 60% iron content (see computation on page 6 of this appendix).	$ 14.02

Metallurgical Coal

Average delivered price of bituminous coking coal at consumers' plants, 1969, per net ton	$ 10.36

Source: Minerals Yearbook, U.S. Bureau of Mines, 1969

Limestone (for fluxing in steel making)

Average price of fluxing limestone and dolomite, 1970, f.o.b. quarry, per net ton	$ 1.53

Source: Minerals Yearbook, U.S. Bureau of Mines, 1970.

Iron and Steel Scrap

Delivered price per net ton, weighted average of four grades delivered to two cities in June, 1969 (see computation on page 7 of this appendix).	$ 25.12

PAPER

Woodpulp

Average U.S. delivered price for all grades woodpulp, per net air-dry ton $128.00

Source: "Paper Trade Journal," June 30, 1969

Waste Paper

Price per net ton, f.o.b. truck shipping point (including brokerage), weighted average of prices for six grades at two cities, as of June 13, 1969 $ 19.17

Source of prices: "Paper Trade Journal," June 30, 1969.

Source of consumption data: Table 21, Salvage Markets for Materials in Solid Waste, Midwest Research Institute, 1972.

GLASS

Glass Sand

Average price per net ton, f.o.b. shipping point $ 4.00

Source: Glass Container Manufacturers Institute, Inc.

Cullet

Average delivered price per net ton $ 20.00

Source: Glass Container Manufacturers Institute, Inc.

Limestone (for fluxing in glass making)

Average price per net ton, f.o.b. shipping point — $ 3.16

Source: Final report of Interstate Commerce Commission in Ex Parte 281, p. 414.

Soda Ash

Average price per net ton, f.o.b. shipping point — $ 35.00

Source: Glass Container Manufacturers Institute, Inc.

Feldspar

Average price for all qualities of crude feldspar in 1968, per net ton — $ 11.07

Source: *Mineral Facts and Problems*, U.S. Bureau of Mines, 1970.

ALUMINUM

Primary Aluminum Ingot

Delivered price of unalloyed ingot, per net ton — $540.00

Source: "Metals Week," June 23, 1969.

Aluminum Scrap

Simple average of wholesale buying prices for several grades of aluminum clips, mixed aluminum clips, old aluminum sheet, aluminum cast, and clean aluminum borings and turnings, delivered to smelters, March, 1971, per net ton — $285.80

Source: "American Metal Market," March 10, 1971.

RUBBER

New Rubber

Weighted average price of natural and synthetic rubber, f.o.b. plant, 1972, per net ton (see computation on page 8 of this appendix).	$536.00

Carbon Black

Average, all grades, July, 1969, per net ton	$160.00

Source: "Oil, Paint and Drug Reporter," July 20, 1969.

Sulphur

Average price, rubber makers' sulphur, in bags, at mines, July, 1969, per net ton	$ 76.00

Source: "Oil, Paint and Drug Reporter," July 20, 1969.

Zinc Oxide

Average for French and American processes, per net ton, freight allowed	$350.00

Source: "Oil, Paint and Drug Reporter," July 20, 1969.

Miscellaneous Rubber Batch Ingredients

Price of miscellaneous inputs to the rubber batch, including plasticizers and anti-oxidants, per net ton	$100.00

Source: Introduction to Rubber Technology, Chapter 17, "Reclaimed Rubber," by J.M. Ball. Reinhold, 2nd Edition, 1966.

Reclaimed Rubber

Average price for whole tire reclaim, f.o.b. shipping point, freight allowed, November, 1972, per net ton	$224.00

Scrap Rubber

Average price per net ton, delivered to reclaimers	$ 14.00

Source: Estimate supplied by Office of Solid Waste Management, Environmental Protection Agency.

Computation of Prices for Iron Ore

Iron Ore - Domestic

Price per gross ton of 51.5% iron natural, bessemer, Mesabi Range, at rail of vessel, lower lake port	$ 10.70
Adjustment to expected analysis of 60% iron content[1] (60 ÷ 51.5)	1.16 times
	$ 12.41
Handling charge, rail of vessel to car, per gross ton	$ .27
Total price per gross ton, loaded in cars	$ 12.68
Total price per net ton (÷ 1.12)	$ 11.55

Iron Ore - Imported (East Coast)

Approximate price per Fe unit of pellets	$ .252
Required Fe units = 60	
Price per gross ton, 60% iron content, at rail of vessel	$ 15.12
Handling charge, rail of vessel to car, per gross ton	$ .27
Total price per gross ton, loaded in cars	$ 15.39
Total price per net ton (÷ 1.12)	$ 14.02

Source: *Iron Ore Analysis and Data*, 1969, The Hanna Mining Co., Cleveland, Ohio.

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[1] Equivalency formula assumes the use of ore with a 60% iron content.

Computation of Price For Iron and Steel Scrap

Scrap Type	% of Total Consumption 1970 1/	Calculated cons. integrated ind. (col. 1÷49 x 100)	June, 1969 Avg. Price, long ton, delivered at Pittsburgh 2/	June, 1969 Avg. Price, long ton, delivered at Chicago 2/	Average Price long ton 3/
No. 1 heavy melting	20.6	42.0	$28.50	$29.50	$12.18
No. 2 heavy melting	5.7	11.6	26.50	25.50	3.02
No. 1 electric & furnace bundles	13.6	27.8	30.50	30.50	8.48
No. 2 & all other bushels	9.1	18.6	24.50	23.50	4.46
Totals	49.0	100.0	--	--	$28.14
Average delivered price, net ton (÷ 1.12)					$25.12

1/ "Iron and Steel Scrap," Preprint 1970, Minerals Yearbook, p. 10, Bureau of Mines

2/ Iron Age, June 26, 1969, p. 99.

3/ Col. 2 x Col. 3 ÷ 100, plus Col. 2 x Col. 4 ÷ 100 ÷ 2.

Note: Cast iron borings (cupola) and other types and grades were omitted; those types and grades are reported as inapplicable to the integrated industry.

Computation of Price for New Rubber

Natural Rubber

Average price No. 1 ribbed smoked sheets, November, 1972, per net ton	$410.00

Source: "Wholesale Prices and Prices for Commodity Groupings," Bureau of Labor Statistics, U.S. Dept. of Commerce, November, 1972

Synthetic Rubber

Average price for four selected grades (regular staining butyl, GN type neoprene, hot styrene butadiene, and non-staining polybutadiene), November, 1972, per net ton	$570.00

Source: "Wholesale Prices and Prices for Commodity Groupings," Bureau of Labor Statistics, U.S. Dept. of Commerce, November, 1972.

Prices weighted according to proportional amount of consumption[1] as follows:

$570 x .785 = $447.45
$410 x .215 = $ 88.17

Weighted Avg. $535.62

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[1] *Rubber Industry Facts*, Rubber Manufacturers Association, New York, New York, 1972.

Appendix G

MEAN MILEAGE AND RATE/TON FOR STUDY MOVES BY COMMODITY

Commodity	No. of Moves	Mean Mileage 1/	Low Rate/Ton, $	Mean Rate/Ton, $ 2/	High Rate/Ton, $
Iron Ore	26	206	1.65	2.63 3/	3.74
I&S Scrap	30	328	3.89	7.71	16.45
Glass Sand	21	625	2.48	6.86	13.54
Cullet	17	450	3.06	8.83	16.84
Woodpulp	48	582	2.34	8.59	21.40
Waste Paper	42	374	5.20	7.06	17.60
Aluminum Ingot	27	1275	2.39	18.47	31.00
Aluminum Scrap	24	591	5.60	16.17	50.40
Natural & Synthetic Rubber	29	962	6.10	18.83	39.70
Reclaimed Rubber	10	606	10.09	14.90	22.45
Scrap Rubber	7	435	10.90	11.46	16.20
Iron Ore, Tidewater origins	8	263	1.81	3.02	3.62
Iron Ore, Ex-Great Lakes	13	161	1.75	2.39	2.56
Iron Ore, Domestic All Rail	5	232	1.65	2.62	3.61

1/ Simple average, i.e., Σ Miles/# of moves

2/ Simple average, i.e., Σ (Rate/Ton)/# of moves

3/ All study ore moves

Source: Master Tables

Appendix H

MEAN TRANSPORTATION PRICES, PER TON AND ADJUSTED BY EQUIVALENCY FACTORS, FOR VIRGIN COMMODITIES USED IN ANALYSIS OF EFFECTS OF TRANSPORTATION

	(1) Mean Freight Rate Per Ton, $	(2) Equiv. Factor	(3) Mean Freight Rate, As Adjusted, $ Col. 1 x Col. 2
Iron and Steel			
Iron Ore, Ex-Lake	2.39	1.58	3.78
Iron Ore, Domestic All-Rail	2.62	1.58	4.14
Iron Ore, Tidewater Origins	3.02	1.58	4.77
Metallurgical Coal	4.90	.30	1.47
Limestone	2.42	.21	.51
Paper			
Woodpulp	8.59	.88	7.56
Glass			
Glass Sand	6.86	.563	3.86
Soda Ash	10.80	.187	2.02
Limestone	2.42	.165	.40
Feldspar	11.00	.085	.94
Aluminum			
Primary Ingot	18.47	.92	16.99
Rubber			
New Rubber	18.83	.470	8.85
Carbon Black	13.46	.200	2.69
Zinc Oxide	14.41	.035	.50
Sulphur	2.04	.030	.06
Misc. Batch Ingredients	13.46	.265	3.57